



Missouri
Department of
Natural Resources

Biological Assessment Study

**Town Branch/Piper Creek
Polk County**

2003-2004

Prepared for:

**Missouri Department of Natural Resources
Water Protection and Soil Conservation Division
Water Protection Program
Water Pollution Control Branch**

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1.0 Introduction

At the request of the Missouri Department of Natural Resources (**MDNR**), Water Pollution Branch (**WPB**), the Environmental Services Program (**ESP**) Water Quality Monitoring Section (**WQMS**) conducted a macroinvertebrate bioassessment of Town Branch and Piper Creek in Polk County near Bolivar, Missouri. One test station on Town Branch and one test station on Piper Creek were sampled 0.5 and 1.7 miles, respectively, downstream of the Bolivar Wastewater Treatment Plant (**WWTF**) (NPDES permit number MO0022373) discharge. One upstream control station on Town Branch and one upstream control station on Piper Creek were also sampled. The Town Branch and Piper Creek sampling stations were compared with ESP's Biological Criteria for Perennial/Wadeable Streams database for the Ozark/Osage Ecological Drainage Unit (**EDU**) and to five regional control streams of similar size to Town Branch and Piper Creek within the Ozark/Osage EDU. A complimentary sediment estimation study was also conducted at the same sample stations to document the amount of suspended solids being deposited on the stream bottom by the Bolivar WWTF effluent.

1.1 Study Area/Justification

Town Branch, a tributary of Piper Creek, originates in Polk County within the city limits of Bolivar and Piper Creek originates in Polk County just south of Bolivar. According to the Missouri Water Quality Standards, Town Branch starting at Highway 83 to its confluence with Piper Creek and Piper Creek downstream of Town Branch to its confluence with the Pomme de Terre River is all classified as Piper Creek. It has a class "P" designation for 7.5 miles. Piper Creek upstream of Town Branch is unclassified and is not listed in the Missouri Water Quality Standards. Therefore, references in this report to the name Town Branch, as found on United States Geological Survey maps, will be called Piper Creek in the Missouri Water Quality Standards. Designated uses for the class "P" section of Piper Creek and Town Branch are "warm water aquatic life protection, human health/fish consumption, and livestock and wildlife watering." There are no designated uses for Piper Creek upstream of the Town Branch confluence since it is an unclassified stream, but it is still under general criteria in the Water Quality Standards (MDNR 2000). Town Branch has 0.5 mile of stream on the 2002 303(d) list for high levels of VSS as a result of the discharge from the Bolivar WWTF. The Bolivar WWTF discharges into Town Branch and has a design flow of 2.55 million gallons per day (mgd) or about 3.95 cubic feet per second (cfs).

In 2003, a study plan was submitted to the MDNR, WPB (Appendix A). The ESP, WQMS was responsible for the proposed bioassessment study on Town Branch and Piper Creek that included the following purpose, objectives, tasks, and null hypotheses.

1.2 Purpose

The purpose of the study is to determine if Town Branch and Piper Creek are impaired by the Bolivar WWTF.

1.3 Objectives

- 1) Determine if the macroinvertebrate community and water quality of Town Branch and Piper Creek, Polk County are affected by the discharge of the Bolivar WWTF.
- 2) Assess the habitat quality for Town Branch and Piper Creek.

1.4 Tasks

- 1) Conduct a bioassessment of the macroinvertebrate community on one upstream control and downstream test station below the Bolivar WWTF on both Town Branch and Piper Creek.
- 2) Conduct a water quality assessment at the sampling stations to determine potential water quality impacts.
- 3) Conduct a habitat assessment at the sampling stations to ensure comparability of aquatic habitats.

1.5 Null Hypotheses

- 1) Macroinvertebrate assemblages of downstream Town Branch and Piper Creek test stations will not substantially differ from upstream control stations.
- 2) Macroinvertebrate assemblages of Town Branch and Piper Creek will not substantially differ from reaches from similar sized regional control streams within the Ozark/Osage EDU.
- 3) Macroinvertebrate assemblages of Town Branch and Piper Creek will not substantially differ from reaches from biocriteria reference streams in the Ozark/Osage EDU.
- 4) Macroinvertebrate assemblages will not substantially differ longitudinally between reaches of Town Branch and Piper Creek.

2.0 Methods

Carl Wakefield and Brian Nodine of the Missouri Department of Natural Resources, Air and Land Protection Division, Environmental Services Program, Water Quality Monitoring Section conducted this study.

2.1 Study Timing

Macroinvertebrate and water quality samples were collected for one fall and spring season. Fall macroinvertebrate sampling was conducted on September 24, 2003. Spring macroinvertebrate sampling and stream habitat assessment were conducted in March 24 & 25, 2004.

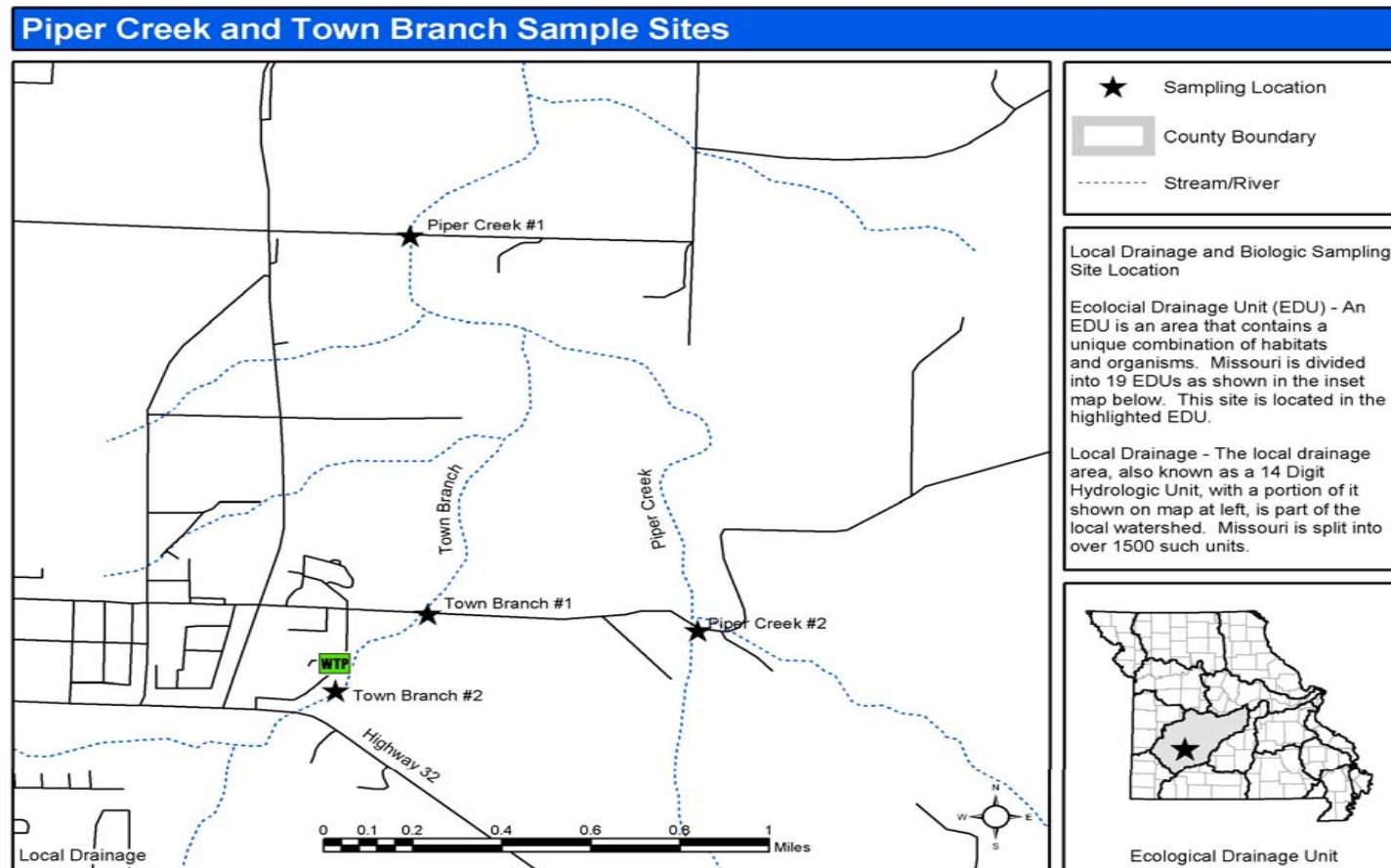
2.2 Station Descriptions

Figure 1 shows the location for the control and test stations for Town Branch and Piper Creek. Table 1 provides legal description and descriptive information for the sample sites of Town Branch, Piper Creek, and the five small regional control stream stations.

Table 1
Station Number, Legal Location, and Descriptive Information for the Test Stations
and Five Regional Control Stream Stations

Station Number	Location ¼, Section, Township, Range	Description	County
Town Branch #1	N ½ sec.6, T. 33 N., R. 22 W.	Test-0.5 Miles Downstream of Bolivar WWTF Discharge at 435 th Road Crossing	Polk
Town Branch #2	SW ¼ sec. 6, T. 33 N., R. 22 W.	Control-Directly Upstream of Bolivar WWTF Discharge	Polk
Piper Creek #1	SW ¼ sec. 31, T. 34 N., R. 22 W.	Test-1.7 Miles Downstream of Bolivar WWTF Discharge at 425 th Road Crossing	Polk
Piper Creek #2	NW ¼ sec. 5, T. 33 N., R. 22 W.	Control-Upstream of Town Branch Confluence at 435 th Road Crossing	Polk
Macks Creek #1	sec. 29, T. 38 N., R. 19 W.	Regional Control	Camden
Starks Creek #1	sec. 23, T. 38 N., R. 20 W.	Regional Control	Hickory
Deer Creek #1	NE ¼ sec. 30, T. 40 N., R. 20 W.	Regional Control	Benton
Barren Fork #1	sec. 16, T. 39 N., R. 13 W.	Regional Control	Miller
Dry Fork #1	SW ¼ sec. 35, T. 35 N., R. 23 W.	Regional Control	Polk

Figure 1: Map of Piper Creek, Town Branch, and Sampling Stations



2.2.1 Ecological Drainage Unit

An EDU is a region in which biological communities and habitat conditions can be expected to be similar. A map of the Ozark/Osage EDU is also included in Figure 1. All stations are within this EDU. Table 2 compares the land cover percentages from the Ozark/Osage EDU and 14-digit Hydrologic Units (HU), which contain the sample stations at Town Branch, Piper Creek, and the five regional control streams. Land cover data were derived from Thematic Mapper satellite data from 1991 to 1993 and interpreted by the Missouri Resource Assessment Partnership (MoRAP). Grassland was the dominant land use of the Town Branch and Piper Creek watersheds and the Ozark/Osage EDU, while most of the regional control streams had more forest cover than grassland in their watersheds (Table 2).

Table 2
Percent Land Cover

Land Cover	14-digit Hydrological Unit (HU)	Urban	Crops	Grassland	Forest	Swamp
EDU	Multiple Hydrological Units	0.3	1.5	49.7	43.4	0
Town Branch and Piper Creek	10290107020003	1.2	0	75.3	22.9	0
Barren Fork	10290111010003	0	0.1	46.9	51.8	0
Deer Creek	10290109040001	0	0	42	50.8	0
Macks Creek	10290110020004	0.2	0	41.8	53.4	0
Starks Creek	10290110020003	0	0	48.9	48.4	0
Dry Fork #1	10290107020004	0	0.2	54.6	44.9	0

2.3 Habitat Assessment

A standardized assessment procedure was followed as described for Riffle/Pool Habitat in the Stream Habitat Assessment Project Procedure (**SHAPP**) (MDNR 2003). The habitat assessment was conducted on all stations during the spring 2004 sampling season.

2.4 Biological Assessment

Biological assessments consist of macroinvertebrate collection and physicochemical sampling for the two sample periods.

2.4.1 Macroinvertebrate Collection and Analysis

A standardized macroinvertebrate sample collection and analysis procedure was followed as described in the Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (**SMSBPP**) (MDNR 2003b). Three standard habitats (flowing water over coarse substrate, depositional substrate in non-flowing water, and root-mat) were sampled at all locations.

Macroinvertebrate data were analyzed using the four general biological metrics found in the SMSBPP. The four metrics used and found in the SMSBPP are: 1) Taxa Richness (**TR**); 2) Ephemeroptera/Plecoptera/Trichoptera Taxa (**EPTT**); 3) Biotic Index (**BI**); and 4) Shannon Diversity Index (**SDI**). The metric evaluations were done by comparing Town Branch and Piper Creek sample stations on a seasonal basis to ESP's Biological Criteria for Perennial/Wadeable Streams database and to the small regional control stream reaches. The biological criteria database used best available reference stream stations within the Ozark/Osage EDU.

2.4.2 Physicochemical Collection and Analysis

Results are shown from physicochemical collections and analyses during each of the 2003 and 2004 sampling periods. Water samples were collected in fall 2003 and spring 2004 for the following parameters: turbidity, ammonia-N, nitrate + nitrite-N, Total Kjeldahl Nitrogen (TKN), chloride, and total phosphorus. Temperature, pH, conductivity, dissolved oxygen, and discharge measurements were collected in the field.

All samples were collected per MDNR-FSS-001: Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations (MDNR 2003e). All samples were kept on ice until they were delivered to the ESP laboratory. The WQMS measured turbidity in the WQMS Biology Laboratory. All other samples were delivered to the ESP, Chemical Analysis Section for analyses.

Results of water quality analyses were compared to Missouri Water Quality Standards (MDNR 2000). Both Town Branch sample stations and Piper Creek #1 are class "P" stream reaches and general warm-water fishery (GWWF) criteria applies to these reaches. Waters designated as GWWF "allow the maintenance of a wide variety of warm-water biota, including naturally reproducing recreationally important fish species". Piper Creek #2 is an unclassified stream

reach and only general criteria in the Missouri Water Quality Standards apply to this stream reach.

Two other criteria were included to identify limits. The first criterion was the reason for protection. In this case, values were identified for the “Protection of Aquatic Life”. The second was the rate of exposure, such as chronic or acute exposure. This was important to determine limits for pollutants that could be tolerated by aquatic life over a period of time.

2.4.3 Discharge

Stream flow was measured at each station using a Marsh-McBirney Flow Meter and discharge was calculated as cubic feet per second (cfs). Methodology was in accordance with the standard operating procedure Flow Measurement in Open Channels (MDNR 2003d).

2.5 Data Analysis

The physicochemical data were examined by variable to identify stations that had elevated levels that were above Water Quality Standards (MDNR 2000). Sampling stations that had elevated levels of certain variables were then discussed with possible influences being identified.

2.6 Quality Control

Quality control was used as stated in the various MDNR Project Procedures and Standard Operating Procedures. Duplicate samples were collected and analyzed for macroinvertebrate and physicochemical parameters. A random number of macroinvertebrate collections were rechecked for specimens missed during laboratory processing.

3.0 Results and Analyses

Three types of analyses were conducted to identify possible impacts to streams. A physical habitat assessment, biological assessment, and physicochemical water analysis were completed.

3.1 Habitat Assessment

Table 3 provides habitat assessment scores for one of the regional control stations (Dry Fork #1, Polk County), upstream control stations, and downstream test stations on Town Branch and Piper Creek. Carl Wakefield and Brian Nodine collected all data in March 2004. According to the SHAPP, for a study station to fully support a biological community, the total score of a test or control station should be 75 to 100 percent similar to the total score of the regional control station. Based on that criterion, all of the upstream control and downstream test stations have comparable habitat except Town Branch #2, which scored 67.6% of the regional test station. Therefore, all stations except Town Branch #2 should have habitat capable of supporting a biological community similar to reference conditions.

Table 3
Habitat Assessment Scores for Regional Control Station, Upstream Control Stations, and
Downstream Test Stations, March 2004

Regional Control Station	Habitat Score	Upstream Control Stations	Habitat Score	% of Reg. Cont.	Downstream Test Stations	Habitat Score	% of Reg. Cont.
Dry Fork #1	151	Town Branch #2	102	67.6	Town Branch #1	128	84.8
		Piper Creek #2	125	82.8	Piper Creek #1	144	95.4

3.2 Biological Assessment

Macroinvertebrate data were evaluated by two methods. The first analysis used the general biological metrics in the SMSBPP. The second analysis of the biological data was an evaluation of macroinvertebrate community composition using percent composition of predominant macroinvertebrate taxa.

3.2.1 Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure (SMSBPP)

The SMSBPP metric evaluation used numeric biocriteria that were calculated from two sources. The first source was ESP's Biological Criteria for Wadeable and Perennial Streams database (Tables 4 and 5) and the second was from the five small regional control streams (Tables 6 and 7) within the Ozark/Osage EDU. Since Town Branch and Piper Creek are considerably smaller than streams in the biological criteria database, the five small regional control streams were chosen based upon similar low flow discharge. These streams were sampled since larger streams may have more available habitat and potentially have higher macroinvertebrate taxa richness than smaller streams.

The metric values and scores for Town Branch and Piper Creek are presented in Tables 8 through 11. Values in Tables 8 and 9 are scored using the biological criteria database reference scores and Tables 10 and 11 are scored using the five small regional control stream scores.

Table 4
Biological Criteria Database Scores for Warm Water Reference Streams Within
Ozark/Osage EDU, Fall Season

	Score = 5	Score = 3	Score = 1
TR	>84	84-42	41-0
EPTT	>17	17-8	7-0
BI	<6.67	6.67-8.33	8.34-10
SDI	>3.23	3.23-1.61	1.60-0

Table 5
Biological Criteria Database Scores for Warm Water Reference Streams Within
Ozark/Osage EDU, Spring Season

	Score = 5	Score = 3	Score = 1
TR	>90	90-45	44-0
EPTT	>26	26-13	12-0
BI	<6.20	6.20-8.10	8.11-10
SDI	>3.27	3.27-1.64	1.63-0

Table 6
Bioassessment Scores for Five Small Regional Control Streams Within
Ozark/Osage EDU, Fall Season

	Score = 5	Score = 3	Score = 1
TR	> 84	84-42	41-0
EPTT	>20	20-10	9-0
BI	<5.90	5.90-7.95	7.96-10
SDI	>3.31	3.31 -1.65	1.64-0

Table 7
Bioassessment Scores for Five Small Regional Control Streams Within
Ozark/Osage EDU, Spring Season

	Score = 5	Score = 3	Score = 1
TR	>103	103-51	50-0
EPTT	>29	29-14	13-0
BI	<5.90	5.90-7.95	7.96-10
SDI	>3.44	3.44-1.72	1.71-0

Piper Creek #1 and Town Branch #2 had a stream condition index (SCI) of 14 while Piper Creek #2 and Town Branch #1 had an SCI of 10 based on biological criteria for the fall sampling season (Table 8). All four sample stations had an SCI of 10 using data from the small regional reference control streams for the fall sampling season (Table 10). There was a decline in all four metric values at Town Branch #1 (downstream test station) compared with Town Branch #2 (upstream control) during the fall 2003 sampling season (Tables 8 and 10). Taxa richness (TR) declined from 75 to 57, EPTT declined from 9 to 7, BI increased from 6.44 to 6.78, and SDI decreased from 3.00 to 2.86 between Town Branch #2 (upstream control) and Town Branch #1 (downstream test station). There was a decline in all of the metric values except TR at Piper Creek #2 (upstream control) compared with Piper Creek #1 (downstream test station) during the fall sampling season (Tables 8 and 10). Taxa richness (TR) increased from 62 to 65, EPTT declined from 9 to 3, BI increased from 6.44 to 6.93, and SDI decreased from 3.13 to 2.97 between Piper Creek #1 (downstream test station) and Piper Creek #2 (upstream

control). The results on Piper Creek indicate that Piper Creek #2 was not a good control since 3 out of 4 metrics performed better at Piper Creek #1 (downstream test station).

Piper Creek #1 and Piper Creek #2 had an SCI of 12, Town Branch #1 had an SCI of 10, and Town Branch #2 had an SCI of 8 based on biological criteria for the spring sampling season (Table 9). All of the stations had an SCI of 10 except Town Branch #2 which had an SCI of 8 using data from the small regional reference control streams for the spring sampling season (Table 11). Piper Creek #2 (upstream control) and Piper Creek #1 (downstream test station) had similar metric values during the spring sampling season. Both of the Town Branch test stations had very low metric values for TR, EPTT, and SDI. Town Branch #1 also had a higher BI value than the other sampling stations (Tables 9 and 11).

Table 8

Piper Creek and Town Branch Metric Values and Scores, Using Biological Criteria Database for Stations in Ozark/Osage EDU, Fall 2003

Sample #/Station	TR	EPTT	BI	SDI	SCI	Sustainability
03-18710						
Piper Creek #1 Value	62	9	6.44	3.13		
Piper Creek #1 Score	3	3	5	3	14	Partial
03-18711						
Piper Creek #2 Value	65	3	6.93	2.97		
Piper Creek #2 Score	3	1	3	3	10	Partial
03-18712						
Town Branch #1 Value	57	7	6.78	2.86		
Town Branch #1 Score	3	1	3	3	10	Partial
03-18713						
Town Branch #2 Value	75	9	6.44	3.00		
Town Branch #2 Score	3	3	5	3	14	Partial

Table 9
Piper Creek and Town Branch Metric Values and Scores, Using Biological Criteria Database for
Stations in Ozark/Osage EDU, Spring 2004

Sample #/Station	TR	EPTT	BI	SDI	SCI	Sustainability
04-18698						
Piper Creek #1 Value	75	10	6.10	2.96		
Piper Creek #1 Score	3	1	5	3	12	Partial
04-18699						
Piper Creek #2 Value	83	9	6.19	2.98		
Piper Creek #2 Score	3	1	5	3	12	Partial
04-18700						
Town Branch #1 Value	51	4	6.92	2.06		
Town Branch #1 Score	3	1	3	3	10	Partial
04-18701						
Town Branch #2 Value	52	5	6.20	1.62		
Town Branch #2 Score	3	1	3	1	8	Partial

Table 10
Piper Creek and Town Branch Metric Values and Scores, Using Five Small Ozark/Osage EDU
Regional Control Stations Data, Fall 2003

Sample #/Station	TR	EPTT	BI	SDI	SCI	Sustainability
03-18710						
Piper Creek #1 Value	62	9	6.44	3.13		
Piper Creek #1 Score	3	1	3	3	10	Partial
03-18711						
Piper Creek #2 Value	65	3	6.93	2.97		
Piper Creek #2 Score	3	1	3	3	10	Partial
03-18712						
Town Branch #1 Value	57	7	6.78	2.86		
Town Branch #1 Score	3	1	3	3	10	Partial
03-18713						
Town Branch #2 Value	75	9	6.44	3.00		
Town Branch #2 Score	3	1	3	3	10	Partial

Table 11
Piper Creek and Town Branch Metric Values and Scores, Using Five Small Ozark/Osage EDU
Regional Control Stations Data, Spring 2004

Sample #/Station	TR	EPTT	BI	SDI	SCI	Sustainability
04-18698						
Piper Creek #1 Value	75	10	6.10	2.96		
Piper Creek #1 Score	3	1	3	3	10	Partial
04-18699						
Piper Creek #2 Value	83	9	6.19	2.98		
Piper Creek #2 Score	3	1	3	3	10	Partial
04-18700						
Town Branch #1 Value	51	4	6.92	2.06		
Town Branch #1 Score	3	1	3	3	10	Partial
04-18701						
Town Branch #2 Value	52	5	6.20	1.62		
Town Branch #2 Score	3	1	3	1	8	Partial

3.2.2 Macroinvertebrate Percent and Community Composition

The number of TR, EPTT, percent Ephemeroptera, percent Plecoptera, percent Trichoptera, and percent composition for the five dominant macroinvertebrate families and taxa at each station are presented in Tables 12 and 14. Mean and standard deviation (SD) values for TR, EPTT, BI, SDI, percent Ephemeroptera, percent Plecoptera, percent Trichoptera, and percent composition of the dominant macroinvertebrate families from the Piper Creek, Town Branch, and small regional control stations are presented in Tables 13 and 15.

Fall 2003 data showed that mayflies were more abundant at Piper Creek #1 (downstream test station), Dry Fork #1 (small regional control), and Town Branch #2 (upstream control) than at Piper Creek #2 (upstream control) and Town Branch #1 (downstream test station). Chironomids, elmids beetles (primarily *Stenelmis*), tubificids, and planariidae were abundant at most of the upstream control and downstream test stations (Table 12). Dry Fork #1 had low numbers for TR and EPTT during the fall sampling season for a small regional control stream probably as a result of very little coarse substrate habitat that could be sampled because of low flow and lack of rootmat. But BI, an indicator of organic pollution, was much lower at Dry Fork #1 than the sampling stations on Town Branch and Piper Creek with *Psephenus herricki*, *Stenelmis*, and Ancyliidae being more abundant. *Baetis* was much more abundant at Piper Creek #1 (downstream control) than the other sample stations. Heptageniid mayflies were more abundant at Piper Creek #1 (downstream control), Town Branch #2 (upstream control), and Dry Fork #1 (small regional control) than the other two sample stations. Water boatmen (Corixidae) made up 6.48 percent of the sample at Piper Creek #2 (upstream control), but did not occur at any other sample stations.

Mean values for fall data comparing Piper Creek and Town Branch test stations, Piper Creek and Town Branch control stations, and small regional control stations are shown in Table 13. Taxa richness (TR), EPTT, SDI, percent Ephemeroptera, and percent Trichoptera were much higher and BI was much lower at the small regional control stations than the control and test stations at Piper Creek and Town Branch. Both the control and test stations from Piper Creek and Town Branch did not have a comparable macroinvertebrate community to the small regional control stations based on community composition and SCI scores. Mayflies were in higher abundance at the small regional control stations while chironomids, tubificid worms, and planarians were more abundant at the Piper Creek and Town Branch stations. Caenidae, Heptageniidae, Isonychiidae, Psephenidae, and Arachnoidea were the more abundant families at the small regional control stations while Elmidae, Planariidae, Chironomidae, and Tubificidae were more abundant in the Piper Creek and Town Branch stations.

Spring 2004 data showed that TR, EPTT, percent Ephemeroptera, percent Plecoptera, and percent Trichoptera were much higher at Dry Fork #1 than the sampling stations on Town Branch and Piper Creek (Table 14). Taxa richness (TR), EPTT, percent Ephemeroptera, percent Plecoptera, and percent Trichoptera were very low at the Town Branch and Piper Creek sampling stations except for percent Ephemeroptera at Piper Creek #2. No stoneflies were present at the Town Branch sampling stations. Chironomids were more abundant at Town Branch/Piper Creek sampling stations than Dry Fork #1. Chironomids were especially high in abundance at the Town Branch sampling stations. *Cricotopus/Orthocladius*, *Polypedilum convictum* group, and *Dicrotendipes* made up much of the chironomid abundance at the Town Branch stations. *Cricotopus/Orthocladius*, *Polypedilum convictum* group, and *Eukiefferiella* made up for most of the chironomid abundance at Piper Creek. Elmid beetles, primarily *Stenelmis*, were abundant at all of the sampling stations. Tubificid worms were fairly abundant at the sampling stations except at Town Branch #2. Planariidae was much more abundant at the two test stations below the Bolivar WWTF discharge (Town Branch #1 and Piper Creek #1).

Table 12

Piper Creek/Town Branch Test and Control Stations and Small Regional Control Station, Dry Fork #1, Macroinvertebrate Composition per Station, Fall 2003. Values in Bold are the Dominant Macroinvertebrate Families and Taxa for Each Sample.

Variable-Station	Piper Creek #1	Piper Creek #2	Town Branch #1	Town Branch #2	Dry Fork #1
Macro Sample Number	03-18710	03-18711	03-18712	03-18713	03-18714
TR	62	65	57	75	59
EPTT	9	3	7	9	9
BI	6.4	6.9	6.8	6.4	5.4
SDI	3.1	3.0	2.9	3.0	2.9
% Ephemeroptera	17.6	1.8	2.0	6.9	15.1
% Plecoptera	0	0	0	0	0.1
% Trichoptera	2.1	0.1	3.6	0.9	1.1
% Dominant Macroinvertebrate Families					
Chironomidae	27.4	22.6	49.7	47.0	24.6
Elmidae	19.0	18.6	20.3	24.0	15.6
Baetidae	10.2	0.2	0.9	2.2	0
Tubificidae	6.4	13.0	7.0	1.8	3.2
Heptageniidae	6.1	0	1.0	4.2	3.5
Hyalellidae	4.9	11.4	0.1	0	0
Corixidae	0	6.5	0	0	0
Planaridae	5.1	6.0	8.6	4.3	0.1
Hydropsychidae	2.1	0.1	3.5	0.4	0.3
Coenagrionidae	5.0	4.6	1.4	5.1	1.2
Psephenidae	2.1	0.3	0.3	1.6	22.2
Ancylidae	4.7	0.5	0.6	1.8	10.2
Caenidae	1.3	1.7	0.1	0.6	5.7
% Dominant Macroinvertebrate Taxa					
<i>Stenelmis</i>	17.3	17.0	20.2	23.4	15.4
<i>Polypedilum convictum</i> grp.	10.8	9.4	16.3	15.0	4.4
<i>Baetis</i>	10.1	0	0.9	2.2	0
Immature Tubificidae	6.0	12.2	7.0	1.8	3.1
Planaridae	5.1	6.0	8.6	4.3	0.1
<i>Hyalella azteca</i>	4.9	11.4	0.1	0	0
Corixidae	0	6.5	0	0	0
<i>Tanytarsus</i>	1.6	2.7	10.0	10.9	6.1
<i>Argia</i>	4.3	0.4	1.2	5.0	1.2
<i>Psephenus herricki</i>	2.0	0.3	0	1.2	22.2
Ancylidae	4.7	0.5	0.6	1.8	10.2
<i>Caenis latipennis</i>	1.3	1.7	0.1	0.6	5.7

Table 13
Piper Creek/Town Branch Test and Control Station Samples and Small Regional Control Station
Samples, Mean (SD) Values for Macroinvertebrate Community Composition, Fall Data

Variable-Station	Piper Creek/Town Branch Test Stations	Piper Creek/Town Branch Control Stations	Small Regional Reference Control Stations
Sample Size (n)	2	2	5
TR	59.5 (3.5)	70.0 (7.1)	86.8 (17.9)
EPTT	8.0 (1.4)	9.0 (4.2)	20.0 (6.6)
BI	6.6 (0.2)	6.7 (0.4)	5.8 (0.3)
SDI	3.0 (0.2)	3.0 (0.0)	3.5 (0.4)
% Ephemeroptera	9.8 (11.1)	4.4 (3.6)	29.0 (11.1)
% Plecoptera	0.0 (0.0)	0.0 (0.0)	0.2 (0.2)
% Trichoptera	2.8 (1.0)	0.5 (0.6)	7.6 (4.3)
% Dominant Macroinvertebrate Families			
Caenidae	0.7 (0.8)	1.1 (0.8)	12.3 (9.2)
Heptageniidae	3.5 (3.6)	2.1 (3.0)	6.9 (2.2)
Isonychiidae	0.0 (0.0)	0.0 (0.0)	3.3 (2.1)
Baetidae	5.4 (6.8)	1.2 (1.5)	1.4 (1.2)
Hydropsychiidae	2.8 (1.0)	0.2 (0.2)	3.5 (4.3)
Elmidae	19.7 (0.9)	21.3 (3.8)	7.9 (4.9)
Psephenidae	1.2 (1.3)	0.9 (0.9)	7.5 (8.9)
Corixidae	0.0 (0.0)	3.2 (4.6)	0.0 (0.0)
Coenagrionidae	3.2 (2.5)	4.9 (0.4)	2.6 (1.3)
Hyaellidae	2.5 (3.3)	5.7 (8.1)	5.8 (5.7)
Ancylidae	2.7 (2.9)	1.2 (0.9)	3.3 (4.0)
Planaridae	6.9 (2.5)	5.2 (1.2)	0.4 (0.6)
Arachnoidea	0.1 (0.2)	0.3 (0.4)	3.5 (2.8)
Chironomidae	38.6 (15.8)	34.8 (17.2)	22.9 (9.8)
Tubificidae	6.7 (2.5)	7.4 (7.9)	1.4 (1.6)

Mean values for spring data comparing Piper Creek and Town Branch test stations, Piper Creek and Town Branch control stations, and small regional control stations are shown in Table 15. Taxa richness (TR), EPTT, SDI, percent Ephemeroptera, percent Plecoptera, and percent Trichoptera were much higher and BI was much lower at the small regional control stations than the stations at Piper Creek and Town Branch. EPTT from the families Caenidae, Heptageniidae, Perlidae, Perlodidae, and Hydroptillidae were more abundant at the small regional control stations than stations at Piper Creek and Town Branch. EPTT from the families Tricorythidae, Siphonuridae, and Nemouridae were present in low numbers at the small regional control stations, but were not present at all in the Piper Creek and Town Branch stations. Taxa from the macroinvertebrate families Elmidae, Chironomidae, and Tubificidae were more abundant at both the control and test stations of Piper Creek and Town Branch than the small reference control streams. Planarians also were much more abundant at the Piper Creek and Town Branch test stations than at the control stations on Piper Creek and Town Branch and the small regional control stations.

3.2.3 Physicochemical Water

Physicochemical results are arranged to demonstrate trends of certain variables that may identify a source of impact to Town Branch and Piper Creek. Results can be found in Table 16 for fall 2003 samples and in Table 17 for spring 2004 samples with outstanding values highlighted in bold. Outstanding results for discharge, chloride, nitrate + nitrite-N, and total phosphorus by season are presented in this section.

Table 14
Piper Creek/Town Branch Test and Control Stations and Small Regional Control Station, Dry Fork #1,
Macroinvertebrate Composition per Station, Spring 2004. Values in Bold are the Dominant
Macroinvertebrate Families and Taxa for Each Sample.

Variable-Station	Piper Creek #1	Piper Creek #2	Town Branch #1	Town Branch #2	Dry Fork #1
Macro Sample Number	04-18698	04-18699	04-18700	04-18701	04-18697
TR	75	83	51	52	103
EPTT	10	9	4	5	23
BI	6.1	6.2	6.9	6.7	5.5
SDI	3.0	3.0	2.1	1.6	3.4
% Ephemeroptera	2.9	6.1	0.6	1.7	6.4
% Plecoptera	1.0	2.0	0	0	9.6
% Trichoptera	0.7	0.1	0.3	0.3	11.3
% Dominant Macroinvertebrate Families					
Chironomidae	48.8	51.9	73.1	84.3	33.6
Elmidae	24.3	14.2	7.3	7.6	19.6
Planariidae	5.5	1.1	7.8	0.4	0.8
Pleuroceridae	4.0	0.3	0	0	0.4
Tubificidae	3.0	6.1	4.3	0.9	3.8
Caenidae	1.3	5.1	0.3	0.7	2.8
Coenagrionidae	0.9	4.9	0.8	0.4	0.2
Arachnoidea	1.2	0.2	2.0	0.4	1.0
Crangonyctidae	0.5	0.4	0.2	2.4	2.4
Heptageniidae	1.6	0.4	0.3	1.0	1.7
Hydroptilidae	0.2	0	0.3	0.2	8.1
Perlidae	0.9	1.9	0	0	6.4
% Dominant Macroinvertebrate Taxa					
<i>Stenelmis</i>	24.1	13.8	6.9	7.5	19.4
<i>Cricotopus/Orthocladius</i>	20.0	9.6	50.8	65.7	8.2
Planariidae	5.5	1.1	7.8	0.4	0.8
<i>Polypedilum convictum</i> grp.	5.2	4.8	2.7	1.7	0.8
<i>Eukiefferiella</i>	4.8	22.5	0	0.2	9.8
<i>Caenis latipennis</i>	1.3	5.1	0.3	0	2.8
<i>Dicrotendipes</i>	1.8	0.3	9.6	6.0	0.3
Immature Tubificidae	2.5	4.3	4.0	0.5	2.8
<i>Hydrobaenus</i>	2.1	0.7	0.3	2.7	2.0
<i>Crangonyx</i>	0.5	0.4	0.2	2.4	2.4
<i>Perlesta</i>	0.9	0	0	0	6.3
<i>Ochrotrichia</i>	0	0	0	0	5.4

Table 15
Piper Creek/Town Branch Test and Control Station Samples and Small Regional Reference
Control Station Samples, Mean (SD) Values for Macroinvertebrate Community Composition,
Spring Data

Variable-Station	Piper Creek/Town Branch Test Stations	Piper Creek/Town Branch Control Stations	Small Regional Reference Control Stations
Sample Size (n)	2	2	5
TR	63.0 (17.0)	67.5 (21.9)	104.8 (6.3)
EPTT	7.0 (4.2)	7.0 (2.8)	29.2 (3.8)
BI	6.5 (0.6)	6.5 (0.4)	5.7 (0.2)
SDI	2.5 (0.6)	2.3 (1.0)	3.6 (0.2)
% Ephemeroptera	1.8 (1.7)	3.9 (3.2)	23.4 (11.0)
% Plecoptera	0.5 (0.7)	1.0 (1.4)	7.9 (4.6)
% Trichoptera	0.5 (0.3)	0.2 (0.1)	6.0 (3.5)
% Dominant Macroinvertebrate Families			
Caenidae	0.8 (0.7)	2.9 (3.1)	12.8 (10.1)
Heptageniidae	0.9 (0.9)	0.7 (0.4)	5.2 (3.4)
Tricorythidae	0.0 (0.0)	0.0 (0.0)	1.8 (2.9)
Siphonuridae	0.0 (0.0)	0.0 (0.0)	1.0 (1.2)
Perlidae	0.5 (0.7)	1.0 (1.4)	2.8 (3.1)
Perlodidae	0.0 (0.1)	0.0 (0.0)	2.1 (2.3)
Nemouridae	0.0 (0.0)	0.0 (0.0)	2.0 (1.5)
Hydroptillidae	0.2 (0.0)	0.1 (0.1)	2.8 (3.1)
Elmidae	15.8 (12.0)	10.9 (4.7)	6.2 (7.6)
Coenagrionidae	0.9 (0.1)	2.7 (3.2)	0.9 (0.4)
Hyaellidae	0.3 (0.2)	1.8 (2.2)	2.2 (1.5)
Crangonyctidae	0.3 (0.2)	0.4 (0.0)	0.9 (0.4)
Pleuroceridae	2.0 (2.8)	0.1 (0.2)	1.8 (1.4)
Planaridae	6.7 (1.6)	0.7 (0.5)	0.5 (0.3)
Arachnoidea	1.6 (0.6)	0.3 (0.1)	4.0 (4.1)
Chironomidae	60.9 (17.2)	68.1 (22.9)	37.9 (5.1)
Tubificidae	3.7 (0.9)	3.5 (3.7)	1.3 (1.5)

3.2.3.1 Discharge

Discharge ranged from 0.02 cfs at Dry Fork #1 (small regional reference control) to 2.55 cfs at Piper Creek #1 during the fall 2003 sampling season (Table 16).

Discharge during the spring 2004 sampling season ranged from 2.69 cfs at Town Branch #2 to 11.20 cfs at Dry Fork #1 (Table 17).

3.2.3.2 Chloride and Nutrients

Chloride and the nutrient parameters of nitrate + nitrite-N and total phosphorous were elevated at Town Branch and Piper Creek test stations during the fall 2003 and spring 2004 sampling seasons.

3.2.3.2.1 Chloride

Chloride ranged from 19.4 mg/L at Piper Creek #2 to 78.8 mg/L at Town Branch #1 during the fall 2003 sampling season with chloride being much higher at the test stations than the control stations (Table 16). The elevated levels of chloride at the test stations were well below the Water Quality Standards (MDNR 2000) chronic value of 230 mg/L and acute value of 860 mg/L for the protection of aquatic life designation.

Chloride ranged from 11.5 mg/L at Dry Fork #1 to 58.8 mg/L at Town Branch #1 during the spring 2004 sampling season (Table 17). Chloride was elevated at the test stations compared to the small regional reference control station and control stations, but was well below Water Quality Standards (MDNR 2000) for chronic and acute toxicity.

3.2.3.2.2 Nitrate + Nitrite-N

Nitrate + nitrite-N ranged from 0.10 mg/L at Piper Creek #2 to 13.4 mg/L at Town Branch #1 (Table 16). Nitrate + nitrite-N was elevated at both of the test stations and the Town Branch (control station) compared to Piper Creek #2 (control station) even though there are no water quality standards for nitrate + nitrite-N in the Missouri Water Quality Standards (MDNR 2000) for protection of aquatic life designation. The only Water Quality Standard (MDNR 2000) for nitrate + nitrite-N is 10.0 mg/L for the designation of drinking water supply.

Nitrate + nitrite-N ranged from 0.09 mg/L at Dry Fork #1 to 8.43 mg/L at Town Branch #1 during the spring 2004 sampling season (Table 17). Nitrate + nitrite-N was elevated at both of the test stations and the Town Branch (control station) compared to Piper Creek #2 (control station) and Dry Fork #1 (small regional reference control station).

3.2.3.2.3 Total Phosphorus

Total phosphorus ranged from 0.03 mg/L at Town Branch #2 to 2.69 mg/L at Town Branch #1 during the fall 2003 sampling season (Table 16). Total phosphorus values at test stations were elevated compared to the control stations, but there are no standards for total phosphorus in the Water Quality Standards (MDNR 2000).

Total phosphorus ranged from 0.02 mg/L at Dry Fork #1 to 0.36 mg/L at Town Branch #1 during the spring 2004 sampling season (Table 17). The total phosphorus value at Town Branch #1 (test station) was slightly elevated compared to the other sampling stations.

Table 16

Physicochemical Variables for Piper Creek/Town Branch Study During the Fall 2003
Sampling Season with Outstanding Values Highlighted in Bold. Only Field Measurements were
Collected at Dry Fork #1. Units mg/L Unless Otherwise Noted.

Variable-Station	Piper Creek #1 Test	Piper Creek #2 Control	Town Branch #1 Test	Town Branch #2 Control	Dry Fork #1 Small Regional Control
Sample Number	03-00823	03-00824	03-00825	03-00826	03-00827
Sample Date	09/24/2003	09/24/2003	09/24/2003	09/24/2003	09/25/2003
Sample Time	1520	1400	1135	0935	0935
pH (Units)	8.30	7.90	7.80	8.10	7.40
Temperature (C ⁰)	21.0	23.0	21.0	18.0	16.5
Conductivity (uS)	675	395	756	534	509
Dissolved O ₂	9.80	6.25	8.30	9.45	5.20
Discharge (cfs)	2.55	0.11	3.09	0.45	0.02
Turbidity (NTUs)	7.90	14.0	4.45	10.6	-
Ammonia-N	0.03	0.03	0.03	0.03	-
Nitrate + Nitrite-N	9.86	0.10	13.40	2.04	-
TKN	0.06	1.02	0.55	0.05	-
Chloride	65.5	19.4	78.8	24.5	-
Total Phosphorus	1.94	0.13	2.69	0.03	-

Table 17

Physicochemical Variables for Piper Creek/Town Branch Study During the Spring 2004
Sampling Season with Outstanding Values Highlighted in Bold. Units mg/L Unless Otherwise
Noted.

Variable-Station	Piper Creek #1 Test	Piper Creek #2 Control	Town Branch #1 Test	Town Branch #2 Control	Dry Fork #1 Small Regional Control
Sample Number	04-11050	04-11051	04-11052	04-11053	04-11062
Sample Date	03/24/2004	03/25/2004	03/24/2004	03/24/2004	03/18/2004
Sample Time	1450	1000	1125	0910	1535
pH (Units)	8.52	7.68	8.31	8.35	8.28
Temperature (C ⁰)	14.0	14.5	13.5	12.5	14.0
Conductivity (uS)	490	397	681	505	389
Dissolved O ₂	14.50	11.80	13.50	14.50	13.50
Discharge (cfs)	11.0	6.96	5.66	2.69	11.20
Turbidity (NTUs)	2.01	5.75	3.41	1.79	2.50
Ammonia-N	0.03	0.03	0.03	0.03	0.03
Nitrate + Nitrite-N	3.00	0.85	8.43	1.74	0.09
TKN	0.12	0.25	0.05	0.05	0.11
Chloride	30.2	15.0	58.8	22.5	11.5
Total Phosphorus	0.11	0.02	0.36	0.01	0.02

4.0 Discussion

The discussion describes possible effects of stream habitat and physicochemical conditions on the biological metric scores and the macroinvertebrate community composition.

4.1 Habitat Assessment and Effects of Sediment Deposition

Results of the stream habitat assessment of March 2004 suggest that all of the test and control stations should be comparable to the regional control stream stations in their ability to support a similar quality macroinvertebrate community, except Town Branch #2 (upstream control station).

The majority of the sample reach of Town Branch #2 was made up of shallow water flowing over bedrock substrate, which was covered with a fine layer of sediment. A sediment deposition and organic solids study in spring 2004 at Town Branch #2 indicated sediment deposition was very high (MDNR 2004). Two sediment deposition estimate surveys were conducted for this study with a mean value of 67 percent coverage for the first survey (March 23, 2004) and a mean value of 90 percent during the second survey (May 11, 2004). Pools made up a very small percentage of the sample reach and the substrate was very poor for macroinvertebrates.

Piper Creek #2 (upstream control station) stream habitat was poor to marginal for some habitat categories even though the overall habitat score indicated that this station should be comparable to the regional control stream stations. Sediment deposition, bank vegetative protection, and riparian zone width scored in either the poor or marginal scoring category. This reach of stream had a very poor riparian zone and was adjacent to pasture land in which cows had previously had access to the stream reach, even though there were no cows near the stream reach during the study. The past agriculture practices probably contributed to high levels of sediment deposition and the low SCI macroinvertebrate scores at this station. A sediment deposition and organic solids study that was conducted in spring 2004 at Piper Creek #2 indicated sediment deposition was high (MDNR 2004). Two sediment deposition estimate surveys were conducted for this study with a mean value of 87 percent coverage for the first survey (March 23, 2004) and a mean value of 49 percent during the second survey (May 11, 2004).

The overall stream habitat score for Town Branch #1 (downstream test station) indicated that it should have a comparable macroinvertebrate community to the regional control stream stations even though a few habitat categories like epifaunal substrate, bank vegetative protection, and riparian zone width for the right bank scored in either the poor or marginal category. A sediment deposition and organic solids study that was conducted in spring 2004 at Town Branch #1 indicated sediment deposition was high (MDNR 2004). Two sediment deposition estimate surveys were conducted for this study. The first was on March 23, 2004 and the second was on May 11, 2004. Both surveys had a mean sediment deposition value of 78 percent.

Piper Creek #1 (downstream test station) had an overall habitat score of 144 which was 95.4 percent of the score of 151 for Dry Fork #1 (regional control stream) which indicates that this station should have a comparable macroinvertebrate community to the regional control stream stations. The only habitat categories that scored poorly at Piper Creek #1 were bank vegetative protection and the riparian zone width for the left bank. A sediment deposition and organic solids study that was conducted in spring 2004 at Piper Creek #1 indicated sediment deposition was low (MDNR 2004). Two sediment deposition estimate surveys were conducted for this study with a mean value of 17 percent coverage for the first survey (March 23, 2004) and a mean value of 18 percent during the second survey (May 11, 2004).

The sediment deposition and organic solids study that was conducted in spring 2004 showed that sediment deposition at the test and control stations was primarily made up of Non-Volatile Suspended Solids (NVSS) and not Volatile Suspended Solids (VSS) (MDNR 2004). The mean VSS:NVSS ratio was 0.16 at Town Branch #1, 0.12 at Town Branch #2, 0.20 at Piper Creek #1, and 0.09 at Piper Creek #2 during the first survey on March 23, 2004. During the second survey on May 11, 2004, the mean VSS:NVSS ratio was 0.03 at Town Branch #1, 0.13 at Town Branch #2, 0.03 at Piper Creek #1, and 0.14 at Piper Creek #2. These results indicate that VSS may not be a problem in 303(d) listed section of stream on Town Branch.

4.2 Nutrient Enrichment Effects on SCI Scores and the Macroinvertebrate Community

Nitrate + nitrite-N, total phosphorus, and chloride were elevated at the test stations on Piper Creek and Town Branch during the fall 2003 sampling season while only nitrate + nitrite-N and chloride were elevated during the spring 2004 sampling season at these stations (Tables 16 and 17). Nitrate + nitrite-N was also elevated at Town Branch #2, an upstream control, during both the fall and spring sampling seasons. These results indicate that most of the nutrient enrichment was coming from the Bolivar WWTF, but the nitrate + nitrite-N values at Town Branch #2 also indicate that some nutrient enrichment was occurring upstream of the Bolivar WWTF. When compared to the small regional control streams (Table 2), Piper Creek and Town Branch watersheds had higher grassland and urban land use percentages. In fact, Town Branch flows through the city of Bolivar and likely receives urban runoff from various sources, leading to the potential for increased nutrients and contaminants at the control and test stations.

The control and test stations on Piper Creek and Town Branch had SCI scores ranging from 8 to 14. This put them in the partial sustainability category for both sample seasons using criteria from both the biocriteria reference streams and the small regional reference control streams of the Ozark/Osage EDU (Tables 8 through 11). Stream Condition Index (SCI) scores, habitat assessment, physicochemical results, and the results from the sediment deposition and organics solids study (MDNR 2004) showed that the control stations on Piper Creek and Town Branch were not ideal control stations. The upstream control stations scored as poorly or even poorer than the test stations. During the fall 2003 sampling season there was a decline of all four metrics in the SCI between Town Branch #2 (upstream control) and Town Branch #1 (downstream test station), which indicates that the Bolivar WWTF was impacting the

macroinvertebrate community. This was not the case during the spring 2004 sampling. The only metric that was better at Town Branch #2 compared to Town Branch #1 during the spring 2004 sampling season was BI, which was 0.72 units lower at Town Branch #2. The results for both sampling seasons at Piper Creek #1 (downstream test station) showed that the macroinvertebrate community began to recover from the impact of the Bolivar WWTF effluent based on increased metric values at this station compared to the metric values at Town Branch #1. Taxa like tubificidae and planariidae that have high BI values had high abundance values at the Piper Creek and Town Branch test stations during both sampling seasons (Tables 12 and 14). Elmidae, primarily made up of *Stenelmis*, were high at both of the test and control stations. The genus *Stenelmis* was not identified to species due to difficulties in identifying larvae, but a previous study by Brown (1972) found that *Stenelmis sexlineata* (BI = 6.4) was tolerant to moderate levels of organic pollution. It is not known what proportion of *Stenelmis* was comprised of this species, but *Stenelmis sexlineata* is a common species in Missouri streams. EPTT and percent EPTT were lower at the test and control stations at Piper Creek and Town Branch than at the small regional control stations (Tables 13 and 15). Taxa that generally had lower BI values were more abundant at the small regional control stations while taxa that generally had higher BI values were more abundant at the Piper Creek and Town Branch stations. Caenidae, Heptageniidae, Isonychiidae, and Psephenidae were more abundant during the fall 2003 sampling season and Caenidae, Heptageniidae, Perlidae, and Perlodidae were more abundant during the spring 2004 sampling season at the small regional control stations than at the Piper Creek and Town Branch sampling stations (Tables 13 and 15). Piper Creek and Town Branch sampling stations generally had higher abundances of Chironomidae, Tubificidae, and Planariidae than the small regional control stations during both sampling seasons. During the spring 2004 sampling season, Planariidae was only higher at the downstream test stations and not at the upstream control stations.

5.0 Conclusions

The first null hypothesis that macroinvertebrate assemblages of downstream Town Branch and Piper Creek test stations would not differ from upstream control stations on Town Branch and Piper Creek was accepted. Both the test and control stations scored in the partial sustainability category for the SCI for both sampling seasons.

The second and third null hypotheses that the macroinvertebrate assemblages of Town Branch and Piper Creek would not differ from the similar sized regional control streams and biocriteria reference streams within the Ozark/Osage EDU was rejected. Both Town Branch and Piper Creek sampling stations scored in the partial sustainability category for the SCI.

The fourth null hypothesis that macroinvertebrate assemblages will not differ longitudinally between reaches of Town Branch and Piper Creek was accepted since all of the sampling stations scored in the partial sustainability category for the SCI for both sampling seasons.

Using both scoring criteria, the control stations for both sampling seasons scored in the partial sustainability category of the SCI, which indicates that these stations were impaired and not ideal controls for comparison with the test stations on Piper Creek and Town Branch. Town Branch #2 (upstream control) was habitat limited from lack of pools and bedrock being the dominant substrate. Water samples at Town Branch #2 also showed that nitrate + nitrite-N was elevated for both sampling seasons. Piper Creek #2 (upstream control) was also habitat limited, probably caused by poor agriculture practices. The test stations on Piper Creek and Town Branch were also impaired based on the SCI scores. Habitat assessment, a sediment deposition and organic solids study (MDNR 2004), and physicochemical analyses indicate that impairment seems to be caused by nutrient enrichment from the Bolivar WWTF effluent and non-point sources and not from VSS deposition on the stream bottom. A sediment deposition and organic solids survey will be repeated sometime during fiscal year 2005 to further document the effects of the Bolivar WWTF contribution to VSS stream bottom deposits.

6.0 Recommendations

1. Conduct a second sediment deposition and organic solids study to further document VSS deposits on the stream bottom and determine if VSS is causing impairment at Town Branch and Piper Creek.
2. Conduct additional water quality monitoring on Piper Creek and Town Branch to determine if nutrient enrichment is a consistent problem and is causing impairment at Piper Creek and Town Branch.
3. Encourage the use of best management practices in the Piper Creek watershed inside and outside the city limits of Bolivar to help control non-point source pollution.

7.0 Literature Cited

- Brown, H. P. 1972. Aquatic dryopoid beetles (Coleoptera) of the United States. U. S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, OH. Water Pollution Control Research Series 18050 ELD04/72. 82 pp.
- Missouri Department of Natural Resources. 2000. Rules of the Department of Natural Resources. Clean Water Commission, Water Quality Standards, 10 CSR, 20-7. Division of Environmental Quality, Water Pollution Control Program, Jefferson City, Missouri 65102. pp. 136.
- Missouri Department of Natural Resources. 2001. Taxonomic Levels for Macroinvertebrate Identification. MDNR-WQMS-209. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 32 pp.
- Missouri Department of Natural Resources. 2002. Biological Criteria for Wadeable/Perennial Streams of Missouri. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 32 pp.
- Missouri Department of Natural Resources. 2003a. Quality Control Procedures for Data Processing. MDNR-WQMS-214. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 6 pp.
- Missouri Department of Natural Resources. 2003b. Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure. MDNR-FSS-030. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 24 pp.
- Missouri Department of Natural Resources. 2003c. Stream Habitat Assessment Project Procedure. MDNR-FSS-032. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 40 pp.
- Missouri Department of Natural Resources. 2003d. Flow Measurements in Open Channels Standard Operating Procedure. MDNR-WQMS-113. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 9 pp.
- Missouri Department of Natural Resources. 2003e. Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations Standard Operating Procedure. MDNR-FSS-001. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 21 pp.
- Missouri Department of Natural Resources. 2004. Sediment Deposition and Organic Solids Evaluation Report, Piper Creek and Town Branch, Polk County, March 23 and May 11, 2004. MDNR Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 11 pp.

Submitted by: _____

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Appendix A

Missouri Department of Natural Resources
Bioassessment Study Plan
Piper Creek/Town Branch
Polk County
August 25, 2003

Missouri Department of Natural Resources
Bioassessment Study Plan
Piper Creek/Town Branch, Polk County
August 25, 2003

Objective

This study will characterize the aquatic macroinvertebrate community in Piper Creek and Town Branch, a tributary of Piper Creek, to determine whether the stream is impaired and warrants continued 303(d) listing for NFR. The State of Missouri Water Quality Standards classifies Piper Creek as a class “P” stream and Town Branch is unclassified. Our specific objectives are to determine: 1) whether there is aquatic life impairment immediately downstream of the WWTF compared to upstream controls, regional control streams, and biocriteria reference streams; and 2) if aquatic life impairment is demonstrated near the WWTF, whether the community recovers downstream of this location.

Null Hypotheses

- 1) Macroinvertebrate assemblages of downstream Piper Creek and Town Branch test stations will not substantially differ from upstream control stations.
- 2) Macroinvertebrate assemblages of Piper Creek and Town Branch will not substantially differ from similar sized regional control streams in the Ozark/Osage Ecological Drainage Unit (EDU).
- 3) Macroinvertebrate assemblages of Piper Creek and Town Branch will not substantially differ from biocriteria reference streams in the Ozark/Osage Ecological Drainage Unit (EDU).
- 4) The macroinvertebrate assemblages will not substantially differ longitudinally between reaches of Piper Creek and Town Branch.

Background

A 0.5-mile segment of Town Branch, in Polk County, is presently on the 303(d) list for the pollutant NFR. During the current year a complimentary study will document the accumulation of suspended solids from the Bolivar WWTF effluent being deposited on the stream bottom. The data from the sediment study will be used along with the biological data from this study to assess the stream condition for Piper Creek and Town Branch. The Bolivar WWTF is an oxidation ditch with a design flow of 3.95-cfs (2.55-MGD) and a reported actual flow of approximately 2.17-cfs (1.40-MGD). There is one permitted outfall, #001, for the oxidation ditch.

Study Design

General: Two Piper Creek, two Town Branch, and one Dry Fork Creek stations will be surveyed. The general locations are as follows: 1) Piper Creek #1 – Polk Co. (SW1/4, Sec. 31, T34N, R22W), test station that is upstream of 425th road crossing; 2) Piper Creek #2 – Polk Co. (NW1/4, Sec. 5, T33N, R22W), control station that is located at 435th road crossing; 3) Town Branch #1 (N1/2, Sec. 6, T33N R22W), test station that is downstream of 435th road; 4) Town Branch #1 (SW1/4, Sec. 6, T33N, R22W), control station that is upstream of Bolivar WWTF effluent and downstream of highway 32; and 5) Dry Fork Creek #1 – Polk Co. (SW1/4, Sec. 35, T35N, R23W), small regional control station that is upstream of highway 83 crossing.

Each station will consist of a length approximately 20 times the average stream width, and will contain at least two riffle areas, as outlined in the Semi-Quantitative Macroinvertebrate Stream Bioassessment Project Procedure (SMBPP). In order to assess comparability among sampling stations, stream discharge, habitat assessment and water chemistry will be determined during macroinvertebrate surveys. Sampling will be conducted during the Fall of 2003 (March 15 through April 15) and Spring of 2004 (September 15 through October 15).

Biological Sampling Methods: Macroinvertebrates will be sampled as per the guidelines of the Semi-Quantitative Macroinvertebrate Stream Bioassessment Project Procedure (SMSBPP). Each of the creeks in this study will be considered “riffle/pool” predominant streams; therefore samples will be collected from flow over coarse substrate, depositional (non-flow) and root-mat habitats. Each macroinvertebrate sample will be a composite of six subsamples within each habitat.

Habitat Sampling Methods: Stream discharge will be measured at each sampling location using a Marsh-McBirney flow meter. Stream habitat assessments will also be conducted within each study area following the guidelines of Stream Habitat Assessment Project Procedure.

Water Quality Sampling Methods: Water samples from all sampled stations will be analyzed at the ESP laboratory for ammonia, nitrogen as $\text{NO}_2 + \text{NO}_3$, total Kjeldahl nitrogen, total phosphorus, chloride and turbidity. Field measurements will include pH, conductivity, temperature and dissolved oxygen.

Laboratory Methods: All samples of macroinvertebrates will be processed and identified as per MDNR-FSS-209, Taxonomic Levels for Macroinvertebrate Identification. Turbidity samples will be analyzed at the MDNR biological laboratory.

Data Recording and Analyses: Macroinvertebrate data will be entered in a Microsoft Access database in accordance with MDNR-WQMS-214, Quality Control Procedures for Data Processing. Data analysis is automated within the Access database. Four standard metrics are calculated according to the SMSBPP: Total Taxa (TT); Ephemeroptera, Plecoptera, Trichoptera Taxa (EPTT); Biotic Index (BI); and the Shannon Index (SI) will

be calculated for each reach. Additional metrics, such as Quantitative Similarity Index for Taxa (QSI-T), or Percent Scrapers (PS) may be employed to discern differences in taxa between control and impacted stations.

Macroinvertebrate data will be analyzed in two specific ways. First, a comparison between the upstream control and downstream test stations on Piper Creek and Town Branch will be performed. Secondly, the data from the Piper Creek and Town Branch sites will be compared to the biological criteria and to metrics calculated from small regional control stream sites from the Ozark/Osage Ecological Drainage Unit (EDU).

Data Reporting: Results of the study will be summarized and interpreted in report format.

Quality Control: As stated in the various MDNR Project Procedures and Standard Operating Procedures.

Literature Cited:

Missouri Department of Natural Resources. 2003a. Stream Habitat Assessment Project Procedure. MDNR-FSS-032. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 40 pp.

Missouri Department of Natural Resources. 2003b. Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure. MDNR-FSS-030. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 24 pp.

Missouri Department of Natural Resources. 2003c. Quality Control Procedures for Data Processing. MDNR-WQMS-214. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 6 pp.

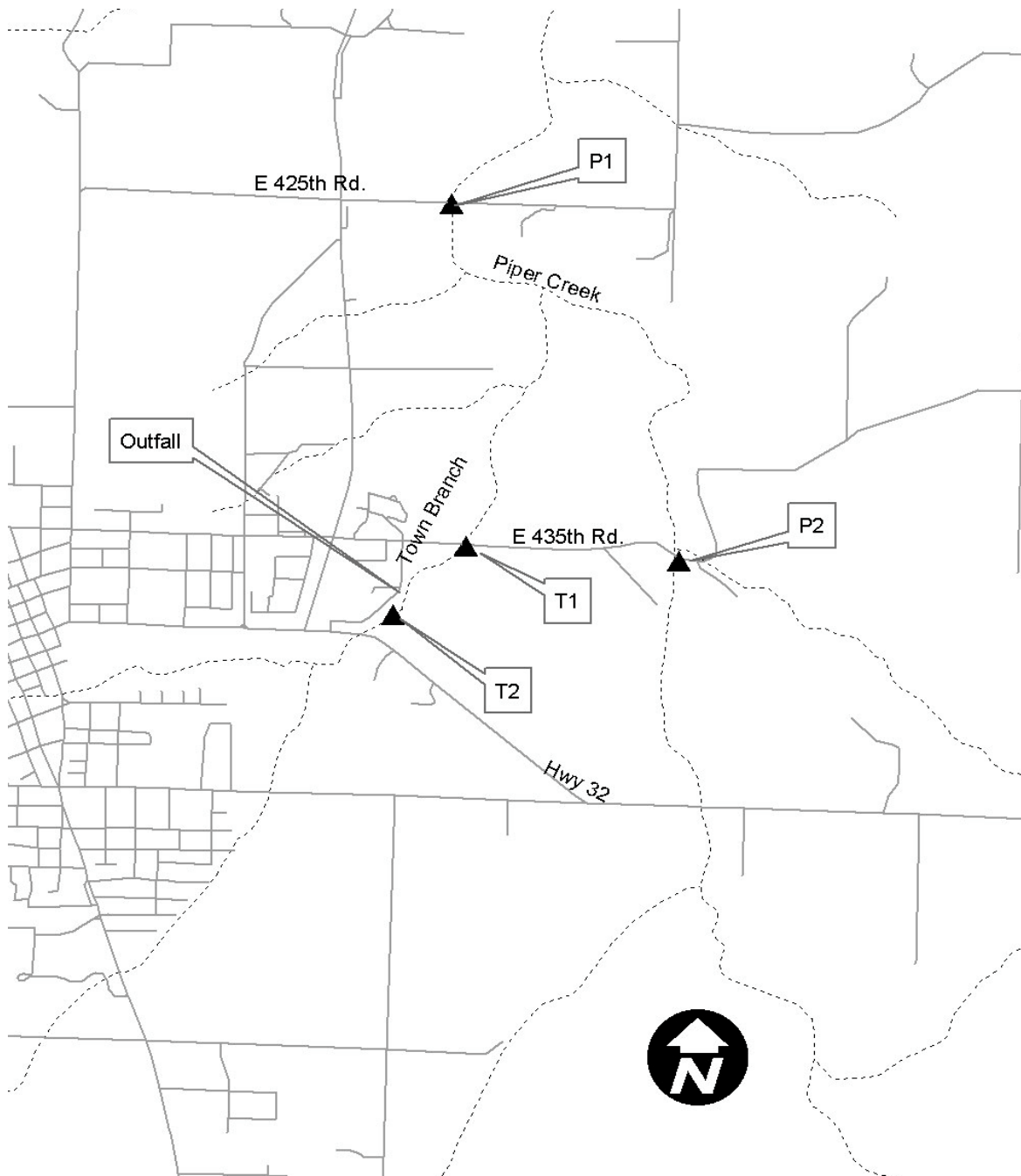
Missouri Department of Natural Resources. 2002. Biological Criteria for Wadeable/Perennial Streams of Missouri. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 32 pp.

Missouri Department of Natural Resources. 2001. Taxonomic Levels for Macroinvertebrate Identification. MDNR-WQMS-209. Missouri Department of Natural Resources, Environmental Services Program, P.O. Box 176, Jefferson City, Missouri 65102. 32 pp.

Attachments

Map of all sampling stations in this study.

Piper Creek/Town Branch Bioassessment Study Sites



Appendix B

Piper Creek/Town Branch Bioassessment Study Macroinvertebrate Bench Sheets

Aquid Invertebrate Database Bench Sheet Report
Piper Ck [0318710], Station #1, Sample Date: 9/24/2003 2:30:00 PM

ORDER: TAXA	CS	NF	SG	RM
N/A				
Branchiobdellida				6
"HYDRACARINA"				
Acarina		1		3
AMPHIPODA				
Hyalella azteca				75
ARHYNCHOBDELLIDA				
Erpobdellidae	1			
COLEOPTERA				
Ancyronyx variegatus				2
Berosus		1		1
Dubiraphia		17		6
Ectopria nervosa	1			
Hydroporus		1		5
Macronychus glabratus		1		1
Psephenus herricki	30	1		
Stenelmis	231	14		21
DECAPODA				
Orconectes virilis		1		2
DIPTERA				
Ablabesmyia	1	12		3
Ceratopogonidae		1		
Chironomus		25		
Corynoneura	4	1		5
Cricotopus/Orthocladus	9	4		16
Cryptochironomus	1	6		
Dicrotendipes		1		
Ephydridae		1		
Glyptotendipes				2
Microtendipes	1	3		1
Nanocladius				4
Paratanytarsus		12		46
Paratendipes		3		
Phaenopsectra		1		2
Polypedilum convictum grp	158	3		6
Polypedilum illinoense grp	1			1
Polypedilum scalaenum grp	3			
Rheotanytarsus	17			7
Stempellinella	3			
Stictochironomus		16		
Tanytarsus	4	5		16
Thienemanniella	14			
Thienemannimyia grp.	4			1
Tipula	-99			
EPHEMEROPTERA				
Apobaetis		1		
Baetis	155			
Caenis latipennis		18		2
Heptageniidae	20			
Proclleon		1		

ORDER: TAXA	CS	NF	SG	RM
Stenacron	17	7		
Stenonema femoratum		5		
Stenonema pulchellum	45			
HEMIPTERA				
Rheumatobates		1		
ISOPODA				
Caecidotea (Blind & Unpigmented)		1		
LEPIDOPTERA				
Petrophila	1			
LIMNOPHILA				
Ancylidae	1	39		33
Helisoma		1		
Physella		2		
LUMBRICULIDA				
Lumbriculidae	9			
MESOGASTROPODA				
Elimia	10	16		-99
ODONATA				
Argia	24	1		41
Enallagma				12
Gomphidae		1		
Hagenius brevistylus		-99		
TRICHOPTERA				
Cheumatopsyche	32			
TRICLADIDA				
Planariidae	70	1		8
TUBIFICIDA				
Limnodrilus hoffmeisteri		6		
Tubificidae	27	62		3
VENEROIDEA				
Sphaerium	15	6		

Aquid Invertebrate Database Bench Sheet Report

Piper Ck [0318711], Station #2, Sample Date: 9/24/2003 1:00:00 PM

ORDER: TAXA	CS	NF	SG	RM
"HYDRACARINA"				
Acarina		5		3
AMPHIPODA				
Hyalella azteca	2			153
ARHYNCHOBDELLIDA				
Erpobdellidae	2			
COLEOPTERA				
Dubiraphia		5		16
Dytiscidae	1			
Hydroporus				5
Psephenus herricki	4			
Scirtes		1		23
Stenelmis	227			4
DECAPODA				
Orconectes luteus	1	-99		
Orconectes virilis		1		1
DIPTERA				
Ceratopogoninae		46		1
Chaoborus		9		
Chironomus	1	1		
Cladotanytarsus		5		
Clinotanypus		1		
Corynoneura	2			
Cryptochironomus	3	1		
Cryptotendipes		2		
Dicrotendipes	1	1		2
Forcipomyiinae	2	1		
Glyptotendipes	1	7		41
Labrundinia				1
Parachironomus	1			8
Parametriocnemus	1			
Paratanytarsus		2		2
Paratendipes	3			1
Polypedilum convictum grp	127			2
Polypedilum halterale grp		2		
Polypedilum illinoense grp	3	1		2
Polypedilum scalaenum grp	15			
Procladius		7		
Pseudochironomus				1
Rheocricotopus				1
Rheotanytarsus	1			
Tabanus	1	-99		
Tanypus		12		
Tanytarsus	24	13		
Thienemannimyia grp.	8			
EPHEMEROPTERA				
Caenis latipennis	8	15		
Callibaetis				2
HEMIPTERA				
Belostoma				-99

ORDER: TAXA	CS	NF	SG	RM
Corixidae		86		2
Neoplea				1
Trepobates				1
LEPIDOPTERA				
Noctuidae	1			
LIMNOPHILA				
Ancylidae		6		1
Menetus				5
LUMBRICULIDA				
Lumbriculidae	6			
MEGALOPTERA				
Corydalus	-99			
Sialis	1	-99		
MESOGASTROPODA				
Elimia	7	2		34
ODONATA				
Argia				5
Basiaeschna janata				1
Coenagrionidae	1			1
Enallagma		1		54
Somatochlora		2		
TRICHOPTERA				
Cheumatopsyche	1			
TRICLADIDA				
Planariidae	69	1		11
TUBIFICIDA				
Aulodrilus		7		
Branchiura sowerbyi		3		
Enchytraeidae	1			
Limnodrilus hoffmeisteri		2		
Tubificidae	85	76		4
VENEROIDEA				
Sphaerium	14			19

Aquid Invertebrate Database Bench Sheet Report

Town Branch [0318712], Station #1, Sample Date: 9/24/2003 10:30:00 AM

ORDER: TAXA	CS	NF	SG	RM
N/A				
Branchiobdellida		2		
AMPHIPODA				
Crangonyx		1		
Hyalella azteca		2		
ARHYNCHOBDELLIDA				
Erpobdellidae	-99	7		8
COLEOPTERA				
Berosus	1	2		3
Dubiraphia		1		1
Ectopria nervosa	1	2		1
Stenelmis	232	22		41
DECAPODA				
Orconectes luteus	-99			
Orconectes virilis				-99
DIPTERA				
Ablabesmyia	1	25		2
Ceratopogoninae		1		
Chironomus	2	50		
Cricotopus bicinctus	6			3
Cricotopus/Orthocladus	29	3		2
Cryptochironomus	15	13		1
Dicrotendipes	1	9		2
Diptera	1			
Forcipomyiinae		1		
Glyptotendipes	1	7		17
Microtendipes	2			
Nanocladius				2
Paratanytarsus	1	10		39
Phaenopsectra		1		1
Polypedilum				1
Polypedilum convictum grp	228	3		7
Polypedilum illinoense grp	11	2		3
Polypedilum scalaenum grp	14	10		2
Pseudochironomus	3			
Rheotanytarsus	15	2		18
Tanytarsus	76	33		37
Thienemanniella	12			
Thienemannimyia grp.	6			
Tipula	-99			-99
EPHEMEROPTERA				
Baetis	13			
Caenis latipennis		1		1
Stenacron	4	1		
Stenonema femoratum	2	7		
HEMIPTERA				
Rhagovelia	2			
LIMNOPHILA				
Ancylidae		9		
Menetus	1	5		5

ORDER: TAXA	CS	NF	SG	RM
Physella		1		1
LUMBRICINA				
Lumbricidae	1			
LUMBRICULIDA				
Lumbriculidae	3			
ODONATA				
Argia	2	6		10
Calopteryx		-99		2
Enallagma				3
Hetaerina		3		
RHYNCHOBDELLIDA				
Glossiphoniidae		2		
TRICHOPTERA				
Cheumatopsyche	43	1		4
Hydropsyche	3			
Hydroptila				1
TRICLADIDA				
Planariidae	109	6		11
TUBIFICIDA				
Limnodrilus hoffmeisteri		1		
Tubificidae	64	35		3
VENEROIDEA				
Pisidium	1	6		
Sphaerium	13	9		11

Aquid Invertebrate Database Bench Sheet Report

Town Branch [0318713], Station #2, Sample Date: 9/24/2003 8:45:00 AM

ORDER: TAXA	CS	NF	SG	RM
N/A				
Branchiobdellida				1
AMPHIPODA				
Crangonyx	2			
ARHYNCHOBDELLIDA				
Erpobdellidae	1	1		-99
COLEOPTERA				
Agabus				1
Dubiraphia		1		6
Ectopria nervosa	2			3
Hydroporus				1
Peltodytes				2
Psephenus herricki	13	1		1
Scirtes		2		
Stenelmis	186	20		91
DECAPODA				
Orconectes luteus	-99			-99
Orconectes virilis	-99	1		1
DIPTERA				
Ablabesmyia	1	4		1
Ceratopogoninae		2		
Chironomus		17		1
Cladotanytarsus		4		
Corynoneura	2			3
Cricotopus bicinctus	3	2		1
Cricotopus/Orthocladus	30	6		12
Cryptochironomus	7	16		
Dicrotendipes		2		
Forcipomyiinae	4	1		
Hemerodromia	1			
Labrundinia				2
Nanocladius	1			5
Nilotanypus	1			
Paralauterborniella		1		
Parametriocnemus	1			
Paratanytarsus	1	3		7
Paratendipes		35		1
Pericoma				1
Phaenopsectra		3		1
Polypedilum	1			
Polypedilum convictum grp	169	2		19
Polypedilum illinoense grp	14	10		15
Polypedilum scalaenum grp	3	16		2
Pseudochironomus	1	2		
Rheotanytarsus	1			7
Stempellinella		3		
Stictochironomus		1		
Tabanus	1			
Tanytarsus	41	25		72
Thienemanniella	2	1		3

ORDER: TAXA	CS	NF	SG	RM
Thienemannimyia grp.	9			3
Tipula	-99			
Tipulidae	1	1		
EPHEMEROPTERA				
Baetis	27			1
Caenis latipennis		6		1
Heptageniidae	4			
Stenacron	8	11		1
Stenonema femoratum	8	20		1
HEMIPTERA				
Microvelia	2	1		
Trepobates		1		
ISOPODA				
Caecidotea		1		
LIMNOPHILA				
Ancylidae	1	7		15
Helisoma	1	-99		
Menetus				17
Physella				1
Planorbella				1
LUMBRICINA				
Lumbricidae	-99	1		
LUMBRICULIDA				
Lumbriculidae	4			
ODONATA				
Argia	15	2		47
Calopteryx				6
Enallagma				1
Hetaerina				10
Somatochlora				1
TRICHOPTERA				
Cheumatopsyche	2			
Hydropsyche	1			
Hydropsychidae	2			
Hydroptila	4	2		
TRICLADIDA				
Planariidae	43	4		8
TUBIFICIDA				
Tubificidae		23		
VENEROIDEA				
Pisidium	1	1		1
Sphaeriidae		7		2

Aquid Invertebrate Database Bench Sheet Report

Dry Fk Ck [0318714], Station #1, Sample Date: 9/25/2003 8:30:00 AM

ORDER: TAXA	CS	NF	SG	RM
"HYDRACARINA"				
Acarina		9		
COLEOPTERA				
Dubiraphia		2		
Psephenus herricki	209			
Scirtes		3		
Stenelmis	144	1		
DECAPODA				
Orconectes luteus	-99	-99		
DIPTERA				
Ablabesmyia	1	2		
Ceratopogoninae		1		
Chaoborus		5		
Chironomus		8		
Cladotanytarsus	1	4		
Corynoneura	7			
Cricotopus bicinctus	1			
Cryptochironomus	4	2		
Dicrotendipes	2	2		
Forcipomyiinae	13	1		
Glyptotendipes		20		
Hemerodromia	1			
Kiefferulus		3		
Labrundinia	2			
Microtendipes		1		
Natarsia		7		
Nilotanypus	8			
Parametriocnemus	1			
Paratanytarsus	1	1		
Paratendipes	3	9		
Polypedilum convictum grp	40	1		
Polypedilum illinoense grp	6			
Rheotanytarsus	5			
Stempellinella	3			
Stictochironomus		3		
Tabanus	5			
Tanypus		1		
Tanytarsus	46	11		
Thienemanniella	3			
Thienemannimyia grp.	22			
EPHEMEROPTERA				
Caenis latipennis	6	48		
Leptophlebiidae	52			
Stenacron	27	2		
Stenonema pulchellum	4			
Tricorythodes	3			
HEMIPTERA				
Rhagovelia	1			
LIMNOPHILA				
Ancylidae	1	95		

ORDER: TAXA	CS	NF	SG	RM
Helisoma		-99		
LUMBRICINA				
Lumbricidae	3	1		
LUMBRICULIDA				
Lumbriculidae	5			
MEGALOPTERA				
Sialis		-99		
MESOGASTROPODA				
Elimia	5	2		
ODONATA				
Argia	11			
Gomphus		1		
Stylogomphus albistylus	2			
PLECOPTERA				
Acroneuria	1			
TRICHOPTERA				
Cheumatopsyche	3			
Chimarra	4			
Helicopsyche	3			
TRICLADIDA				
Planariidae	1			
TUBIFICIDA				
Aulodrilus		1		
Tubificidae	12	17		
VENEROIDEA				
Sphaerium	3	2		

Aquid Invertebrate Database Bench Sheet Report

Dry Fk Ck [0418697], Station #1, Sample Date: 3/18/2004 2:00:00 PM

ORDER: TAXA	CS	NF	SG	RM
N/A				
Branchiobdellida				2
"HYDRACARINA"				
Acarina	2	10		2
AMPHIPODA				
Crangonyx	1	13		19
Hyalella azteca	1	4		22
ARHYNCHOBDELLIDA				
Erpobdellidae	1	-99		
COLEOPTERA				
Berosus		2		
Dubiraphia		2		1
Hydroporus		20		3
Paracymus				1
Psephenus herricki	5			
Scirtes				2
Stenelmis	259	4		5
Tropisternus				1
DECAPODA				
Orconectes luteus	1	2		
Orconectes virilis				1
DIPTERA				
Ablabesmyia		12		1
Ceratopogoninae	2	1		
Chironomus		1		
Cladotanytarsus	1	2		
Clinocera	2	2		1
Corynoneura		1		6
Cricotopus bicinctus	2			
Cricotopus/Orthocladius	57	4		52
Cryptochironomus	1	1		
Demicryptochironomus	1			
Dicrotendipes		3		1
Diptera		1		1
Dixella				2
Eukiefferiella	102	1		32
Glyptotendipes		3		7
Hemerodromia	1			
Hexatoma	4			
Hydrobaenus	1	22		4
Microtendipes				1
Nanocladius				1
Natarsia		4		1
Nilotanypus	1			
Orthocladius (Euorthocladius)	2			1
Parametriocnemus	16			3
Paratanytarsus		2		13
Paratendipes		16		
Phaenopsectra		1		
Polypedilum convictum grp	11			

ORDER: TAXA	CS	NF	SG	RM
Polypedilum illinoense grp				4
Potthastia				1
Procladius		5		
Prosimulium	2			
Rheocricotopus				1
Simulium	25			
Stempellinella		5		2
Stictochironomus		9		1
Sympotthastia	6			3
Tabanus	-99			
Tanypus		1		
Tanytarsus	6	9		5
Thienemanniella				1
Thienemannimyia grp.	1			1
Tipula	1			
Tribelos		7		
Zavreliomyia		5		1
EPHEMEROPTERA				
Acentrella	15			5
Caenis latipennis	8	23		7
Leptophlebia		3		2
Paraleptophlebia		2		
Stenacron		7		
Stenonema femoratum	2	11		2
Stenonema pulchellum	1			
HEMIPTERA				
Trichocorixa		1		
LIMNOPHILA				
Ancylidae	1	4		
Fossaria		2		
Helisoma				-99
Physella	-99	2		1
LUMBRICINA				
Lumbricidae	5	1		
LUMBRICULIDA				
Lumbriculidae	2	1		1
MEGALOPTERA				
Corydalus	-99			
Sialis		-99		
MESOGASTROPODA				
Elimia		3		2
ODONATA				
Basiaeschna janata				1
Enallagma		2		1
PLECOPTERA				
Acroneuria	1			
Amphinemura	2			1
Chloroperlidae	28			1
Clioperla clio	1			3
Isoperla	8			
Leuctridae				1
Perlesta	78			9

ORDER: TAXA	CS	NF	SG	RM
Perlinella drymo		-99		
TRICHOPTERA				
Agapetus	31			
Agrypnia				-99
Cheumatopsyche	7			1
Helicopsyche	1			
Hydroptila	27	4		6
Ochrotrichia	55			20
Pycnopsyche		2		1
Rhyacophila	1			
TRICLADIDA				
Planariidae	11			
TUBIFICIDA				
Enchytraeidae		4		2
Limnodrilus cervix		3		
Limnodrilus claparedianus		2		
Limnodrilus hoffmeisteri	2	7		1
Tubificidae	8	29		1
VENEROIDEA				
Pisidium	6			
Sphaerium	3	2		

Aquid Invertebrate Database Bench Sheet Report

Piper Ck [0418698], Station #1, Sample Date: 3/24/2004 3:10:00 PM

ORDER: TAXA	CS	NF	SG	RM
N/A				
Branchiobdellida				4
"HYDRACARINA"				
Acarina		13		
AMPHIPODA				
Crangonyx		1		4
Hyalella azteca				1
ARHYNCHOBDELLIDA				
Erpobdellidae	-99	-99		-99
COLEOPTERA				
Berosus	1			
Dubiraphia				1
Dytiscidae				4
Hydroporus		1		6
Macronychus glabratus				1
Psephenus herricki	15	-99		
Stenelmis	224	16		22
DECAPODA				
Orconectes luteus	-99			-99
Orconectes virilis				1
DIPTERA				
Ceratopogoninae		4		
Cladotanytarsus		3		
Clinotanypus		1		
Cricotopus bicinctus				6
Cricotopus/Orthocladius	93	64		60
Cryptochironomus	1	5		
Cryptotendipes		1		
Dicrotendipes	1	14		4
Endochironomus		1		
Eukiefferiella	47			5
Glyptotendipes		4		3
Hydrobaenus	2	12		9
Micropsectra				5
Microtendipes		2		
Nanocladius				2
Nilotanypus	1			2
Ormosia		1		
Orthocladius (Euorthocladius)	1			
Parachironomus				2
Paratanytarsus		1		9
Paratendipes		18		
Phaenopsectra	1			
Polypedilum convictum grp	50			6
Polypedilum illinoense grp	2	1		6
Polypedilum scalaenum grp	5	11		1
Procladius		1		
Prosimum	2			
Pseudochironomus	1			
Rheotanytarsus	2	1		15

ORDER: TAXA	CS	NF	SG	RM
Simulium	7			1
Stictochironomus		8		
Tanytarsus	4	16		15
Thienemannimyia grp.	2			3
Tipula	-99			-99
EPHEMEROPTERA				
Baetidae		1		
Caenis latipennis	1	10		3
Stenacron	3	4		
Stenonema pulchellum	8	1		1
LIMNOPHILA				
Ancylidae	1			5
Physella				4
LUMBRICINA				
Lumbricidae		1		
LUMBRICULIDA				
Lumbriculidae	1			
MESOGASTROPODA				
Elimia	3			40
ODONATA				
Argia	1			2
Basiaeschna janata				-99
Calopteryx				5
Enallagma				7
Libellula				-99
PLECOPTERA				
Isoperla	1			
Perlesta	9	1		
RHYNCHOBDELLIDA				
Glossiphoniidae				1
TRICHOPTERA				
Cheumatopsyche	4			1
Hydropsyche	1			
Hydroptila	1	1		
Ironoquia				-99
TRICLADIDA				
Planariidae	45	1		14
TUBIFICIDA				
Aulodrilus		1		
Enchytraeidae	3	1		2
Limnodrilus hoffmeisteri	2	3		
Tubificidae		27		
VENEROIDEA				
Sphaerium	5	1		

Aquid Invertebrate Database Bench Sheet Report

Piper Ck [0418699], Station #2, Sample Date: 3/25/2004 10:15:00 AM

ORDER: TAXA	CS	NF	SG	RM
"HYDRACARINA"				
Acarina		2		1
AMPHIPODA				
Crangonyx		4		3
Hyalella azteca		2		52
ARHYNCHOBDELLIDA				
Erpobdellidae	3			2
COLEOPTERA				
Dubiraphia				6
Hydroporus		2		12
Peltodytes				1
Scirtes				1
Stenelmis	202	10		11
DECAPODA				
Orconectes luteus	-99			
Orconectes virilis		-99		1
DIPTERA				
Ablabesmyia		1		
Ceratopogoninae	1	27		1
Cladotanytarsus		5		
Clinotanypus		2		1
Cricotopus bicinctus		1		
Cricotopus/Orthocladius	96	6		53
Cryptochironomus	3	1		
Cryptotendipes		2		
Dicrotendipes	2			3
Diplocladius	1			
Endochironomus		1		
Eukiefferiella	357	2		4
Glyptotendipes		7		28
Hydrobaenus	1	5		5
Labrundinia				2
Micropsectra	1			3
Orthocladius (Euorthocladius)	6			
Parachironomus				1
Parakiefferiella				1
Paratanytarsus				1
Paratendipes	1	23		4
Pilaria	1			
Polypedilum convictum grp	77			
Polypedilum fallax grp				1
Polypedilum halterale grp		4		
Polypedilum scalaenum grp	46			
Potthastia	1	1		
Procladius		8		
Prosimum	1			
Pseudosmittia				1
Simulium	17			
Stictochironomus		1		
Tabanus	-99			

ORDER: TAXA	CS	NF	SG	RM
Tanypus				1
Tanytarsus	13	31		18
Thienemanniella	1			
Thienemannimyia grp.	1			1
Tipula	1			-99
EPHEMEROPTERA				
Acentrella	8			
Caenis latipennis	17	48		17
Leptophlebiidae		1		1
Stenacron	3	1		
Stenonema femoratum		1		2
HEMIPTERA				
Ranatra fusca				1
Trichocorixa		1		2
LIMNOPHILA				
Ancylidae	1			
Fossaria	1			
Helisoma				-99
Menetus				4
Physella		2		2
LUMBRICINA				
Lumbricidae		2		
LUMBRICULIDA				
Lumbriculidae				1
MEGALOPTERA				
Corydalus	-99			
MESOGASTROPODA				
Elimia	1			3
ODONATA				
Argia	-99			11
Enallagma		2		65
Ischnura		1		
Nasiaeschna pentacantha				1
Perithemis		-99		
PLECOPTERA				
Acroneuria	-99			
Isoperla	1			
Perlidae	31			
RHYNCHOBDELLIDA				
Glossiphoniidae		1		
TRICHOPTERA				
Cheumatopsyche	2			
TRICLADIDA				
Planariidae	8	4		5
TUBIFICIDA				
Aulodrilus		3		2
Branchiura sowerbyi		3		
Enchytraeidae	8	4		4
Limnodrilus claparedianus	1	1		
Limnodrilus hoffmeisteri	12	6		1
Tubificidae	20	42		8
VENEROIDEA				

ORDER: TAXA	CS	NF	SG	RM
Sphaeriidae	30	14		1

Aquid Invertebrate Database Bench Sheet Report

Town Branch [0418700], Station #1, Sample Date: 3/24/2004 12:00:00 PM

ORDER: TAXA	CS	NF	SG	RM
N/A				
Gordiidae	3			
"HYDRACARINA"				
Acarina		23		1
AMPHIPODA				
Crangonyx				2
Hyaella azteca	1	4		
ARHYNCHOBDELLIDA				
Erpobdellidae	3	1		-99
COLEOPTERA				
Agabus		1		
Dubiraphia		3		1
Macronychus glabratus				1
Psephenus herricki	1			
Stenelmis	64	3		17
Tropisternus	1			
DIPTERA				
Ablabesmyia		1		1
Brillia	1			
Ceratopogoninae		6		
Cricotopus bicinctus				10
Cricotopus/Orthocladus	431	63		123
Cryptochironomus	2	5		1
Demicryptochironomus		1		
Dicrotendipes	13	85		19
Diplocladius	1			
Glyptotendipes				4
Hydrobaenus	1	3		
Microtendipes	2			
Paratanytarsus		1		3
Paratendipes		1		
Polypedilum	1			
Polypedilum convictum grp	23			10
Polypedilum illinoense grp	11	3		19
Polypedilum scalaenum grp	18	7		
Pseudochironomus		1		1
Psychodidae		1		
Rheotanytarsus	1			1
Tanytarsus	5	5		5
Thienemanniella	1			
Thienemannimyia grp.	2			1
Tipula	-99			-99
EPHEMEROPTERA				
Caenis latipennis		4		
Stenonema femoratum	3			
HEMIPTERA				
Trichocorixa		1		
LIMNOPHILA				
Menetus				1
Physella		2		1

ORDER: TAXA	CS	NF	SG	RM
ODONATA				
Argia				9
Calopteryx				1
Enallagma				1
TRICHOPTERA				
Hydropsyche				1
Hydroptila	3			
TRICLADIDA				
Planariidae	45	7		43
TUBIFICIDA				
Enchytraeidae	2	1		
Limnodrilus hoffmeisteri	1	2		
Tubificidae	11	38		
VENEROIDEA				
Sphaeriidae	1	12		

Aquid Invertebrate Database Bench Sheet Report

Town Branch [0418701], Station #2, Sample Date: 3/24/2004 9:30:00 AM

ORDER: TAXA	CS	NF	SG	RM
"HYDRACARINA"				
Acarina	1	3		
AMPHIPODA				
Crangonyx	2	5		21
ARHYNCHOBDELLIDA				
Erpobdellidae	-99	1		-99
COLEOPTERA				
Dubiraphia		2		
Dytiscidae		1		1
Ectopria nervosa		1		1
Hydroporus		1		
Stenelmis	44	22		20
DECAPODA				
Orconectes luteus	-99	-99		-99
Orconectes virilis				-99
DIPTERA				
Brillia				1
Ceratopogoninae		1		
Corynoneura				1
Cricotopus bicinctus	4	3		10
Cricotopus/Orthocladius	491	115		151
Cryptochironomus	1	6		
Dicrotendipes	4	49		16
Diptera	1			
Eukiefferiella	2			
Hydrobaenus	5	21		5
Micropsectra				2
Nanocladius				1
Orthocladius (Euorthocladius)	1			
Parametriocnemus				2
Paratanytarsus	2			
Paratendipes		1		
Polypedilum convictum grp	18			2
Polypedilum illinoense grp	2	1		5
Polypedilum scalaenum grp	3	16		
Pseudochironomus		1		
Stictochironomus		1		
Tanytarsus	4	9		10
Thienemanniella	1			
Thienemannimyia grp.	1			4
Tipula				-99
EPHEMEROPTERA				
Caenis punctata		7		1
Stenacron	4	3		
Stenonema femoratum	3	1		
HEMIPTERA				
Trichocorixa		1		
LEPIDOPTERA				
Petrophila	1			
LIMNOPHILA				

ORDER: TAXA	CS	NF	SG	RM
Ferrissia	1			
Physella				1
LUMBRICULIDA				
Lumbriculidae	1			
ODONATA				
Argia				5
Calopteryx				4
TRICHOPTERA				
Hydropsyche	1			
Hydroptila	2			
TRICLADIDA				
Planariidae		3		1
TUBIFICIDA				
Enchytraeidae	1			
Limnodrilus hoffmeisteri		4		
Tubificidae		6		
VENEROIDEA				
Sphaerium	1	1		

Aquid Invertebrate Database Bench Sheet Report

Barren Fk [0218109], Station #1, Sample Date: 9/24/2002 10:15:00 AM

ORDER: TAXA	CS	NF	SG	RM
N/A				
Gordiidae	-99			
"HYDRACARINA"				
Acarina	47	5		1
AMPHIPODA				
Allocrangonyx		1		
Hyaella azteca	4			159
COLEOPTERA				
Berosus	12			1
Dubiraphia		2		17
Ectopria nervosa	4	1		
Helichus lithophilus	2			
Psephenus herricki	116	1		
Scirtes				5
Stenelmis	18	26		
DECAPODA				
Orconectes luteus		-99		-99
Orconectes virilis				-99
DIPTERA				
Ablabesmyia		6		1
Ceratopogoninae	4			
Chironomus		6		3
Corynoneura	2			
Cricotopus/Orthocladus	1			
Cryptochironomus		1		
Dicrotendipes		1		6
Dixella				1
Forcipomyiinae	2			
Labrundinia	1			
Limonia	1			
Microtendipes				1
Nilotanytus	3			
Parametriocnemus	4			
Paratanytarsus				5
Polypedilum convictum grp	30			
Polypedilum fallax grp				1
Polypedilum illinoense grp				4
Pseudochironomus	14			
Rheocricotopus	1			
Rheotanytarsus	5			
Stempellinella	1			
Stenochironomus	1			
Tabanus	-99			
Tanytarsus	6	1		
Thienemanniella	3			
Thienemannimyia grp.	10			
Tipula	2			
Zavreliella	1			
Zavreliomyia		2		
EPHEMEROPTERA				

ORDER: TAXA	CS	NF	SG	RM
Acerpenna	6			
Baetis	6			
Caenis anceps	21	24		
Caenis latipennis	14	192		8
Choroterpes		4		
Fallceon	1			
Heptageniidae	3	2		
Isonychia bicolor	56			
Stenonema femoratum	1	34		1
Stenonema mediopunctatum	7			
Stenonema pulchellum	30			
Tricorythodes	29			
HEMIPTERA				
Microvelia				1
LEPIDOPTERA				
Petrophila	8			
LIMNOPHILA				
Ferrissia	1			10
Helisoma	1			
Laevapex	3			
Menetus	3			3
Physella	16			4
LUMBRICINA				
Lumbricidae		1		1
MEGALOPTERA				
Corydalus	1			
Sialis	-99			
MESOGASTROPODA				
Elimia	13	-99		12
ODONATA				
Argia	18	2		1
Basiaeschna janata				-99
Calopteryx				1
Enallagma				5
Erythemis				-99
Gomphus		1		
Hagenius brevistylus	9	-99		
Stylogomphus albistylus	16			
PLECOPTERA				
Neoperla	5	1		
Zealeuctra	2			
TRICHOPTERA				
Cheumatopsyche	65			
Chimarra	17			
Helicopsyche	8			
Hydropsyche	4			
Hydroptila	23			
Triaenodes				18
TRICLADIDA				
Planariidae	4			
TUBIFICIDA				
Tubificidae		3		

Aquid Invertebrate Database Bench Sheet Report

Deer Ck [0218113], Station #1, Sample Date: 9/25/2002 6:00:00 PM

ORDER: TAXA	CS	NF	SG	RM
"HYDRACARINA"				
Acarina	55	17		15
AMPHIPODA				
Allocrangonyx		2		
Hyalella azteca		3		52
Stygobromus		3		
COLEOPTERA				
Ancyronyx variegatus				1
Berosus		2		
Dubiraphia		3		26
Helichus lithophilus				3
Hydroporus		1		
Macronychus glabratus				5
Psephenus herricki	29			
Scirtes				5
Stenelmis	5	20		1
DECAPODA				
Orconectes luteus	-99			
Orconectes virilis				1
DIPTERA				
Ablabesmyia	2	17		6
Anopheles				5
Ceratopogoninae	3	10		1
Chaoborus		1		
Chironomus		38		1
Cladotanytarsus	6	4		2
Clinotanypus				1
Corynoneura	4	1		1
Cricotopus/Orthocladius	3	1		
Cryptochironomus	1			
Culex				2
Dasyheleinae	1			
Dicrotendipes		4		8
Dixella				9
Forcipomyiinae	1			1
Hexatoma	7			
Labrundinia	1	3		3
Microtendipes	1			
Nanocladius				2
Nilotanypus	18	1		2
Parametriocnemus	28			1
Paratanytarsus		2		12
Paratendipes		8		5
Phaenopsectra	1			2
Polypedilum	5			
Polypedilum convictum grp	34			4
Polypedilum illinoense grp	2			
Polypedilum scalaenum grp	2	1		
Procladius		13		
Pseudochironomus		4		

ORDER: TAXA	CS	NF	SG	RM
Rheocricotopus	9			
Rheotanytarsus	5			
Simulium	5			
Stempellinella	4			
Stenochironomus	2			
Tabanus	2			
Tanytarsus	14	14		5
Thienemanniella	2			1
Thienemannimyia grp.	30	9		1
undescribed Empididae	2			
EPHEMEROPTERA				
Acerpenna	3			
Apobaetis		3		
Caenis anceps	11			
Caenis latipennis	5	31		5
Choroterpes	2			
Heptageniidae	33			1
Hexagenia		9		
Isonychia bicolor	37			1
Leptophlebiidae		5		
Procloeon		2		2
Stenacron	3			
Stenonema femoratum	1			
Stenonema mediopunctatum	3			
Stenonema pulchellum	52			5
Tricorythodes	23			
HEMIPTERA				
Microvelia	1			
LIMNOPHILA				
Ancylidae				9
Ferrissia	14	1		9
Menetus	4	1		2
Physella	2			4
LUMBRICINA				
Lumbricidae	3	2		
MEGALOPTERA				
Corydalus	-99			
Sialis		1		
MESOGASTROPODA				
Elimia	18			20
Hydrobiidae		3		5
ODONATA				
Argia	23			2
Boyeria				1
Didymops		-99		
Enallagma		3		18
Gomphus		-99		
Hagenius brevistylus	3			
Libellula		1		
Macromia		-99		-99
Stylogomphus albistylus	5			
PLECOPTERA				

ORDER: TAXA	CS	NF	SG	RM
Perlinella ephyre	1	1		
RHYNCHOBDELLIDA				
Glossiphoniidae				2
TRICHOPTERA				
Cheumatopsyche	5			3
Chimarra	10			
Helicopsyche	40			
Lype diversa				1
Mystacides		1		
Nyctiophylax				1
Oecetis	7	1		4
Oxyethira		8		
Triaenodes				8
TRICLADIDA				
Planariidae				3
TUBIFICIDA				
Aulodrilus				1
Branchiura sowerbyi		5		5
Limnodrilus hoffmeisteri		4		
Tubificidae	2	11		6
VENEROIDEA				
Sphaerium		2		

Aquid Invertebrate Database Bench Sheet Report

Macks Ck [0218115], Station #1, Sample Date: 9/26/2002 11:00:00 AM

ORDER: TAXA	CS	NF	SG	RM
"HYDRACARINA"				
Acarina	38	3		11
AMPHIPODA				
Allocrangonyx		-99		
Hyalella azteca				131
COLEOPTERA				
Berosus	1			1
Dubiraphia		28		17
Ectopria nervosa	3	17		
Hydrophilidae	2			
Macronychus glabratus				5
Microcylloepus pusillus	3			6
Paracymus				1
Psephenus herricki	6	9		
Scirtes				3
Stenelmis		63		
DECAPODA				
Orconectes luteus	-99			
DIPTERA				
Ablabesmyia		1		
Ceratopogoninae	1	1		
Cricotopus bicinctus	2			
Cricotopus/Orthocladius	18	1		11
Cryptochironomus		1		
Dasyheleinae	1			
Dicrotendipes		1		1
Hemerodromia	3			
Labrundinia				1
Microtendipes	1			
Nilotanypus	1			
Parametriocnemus	1			
Paratanytarsus		2		10
Paratendipes		1		
Pentaneura	12			
Polypedilum convictum grp	21			
Polypedilum illinoense grp		1		1
Pseudochironomus	1	3		
Rheocricotopus	7			
Rheotanytarsus	33			
Simulium	1			
Stenochironomus				5
Tabanus	2	-99		
Tanytarsus	7	2		
Thienemanniella	35	16		6
Thienemannimyia grp.	5			1
Tipula	2			
undescribed Empididae		1		
EPHEMEROPTERA				
Acerpenna	27			
Baetis	8			

ORDER: TAXA	CS	NF	SG	RM
Baetiscidae		1		
Caenis anceps	10			
Caenis latipennis	17	48		11
Choroterpes		6		
Eurylophella bicolor				1
Heptageniidae	28			
Isonychia bicolor	43			
Leptophlebiidae		14		
Leucrocuta	1			
Procloeon		1		1
Stenonema femoratum		23		2
Stenonema mediopunctatum	46			
Stenonema pulchellum	11			
Tricorythodes	109			1
HEMIPTERA				
Rhagovelia	1			
Rheumatobates				5
ISOPODA				
Caecidotea (Blind & Unpigmented)		2		
LIMNOPHILA				
Ancylidae	2	5		1
Helisoma				-99
Menetus		1		1
Physella				2
LUMBRICINA				
Lumbricidae		1		
MEGALOPTERA				
Corydalus	3			
Sialis		-99		
MESOGASTROPODA				
Elimia	21	1		5
ODONATA				
Argia	4	3		4
Basiaeschna janata				-99
Calopteryx				3
Enallagma				10
Gomphidae		6		
Hagenius brevistylus		1		
Ophiogomphus	2	4		
PLECOPTERA				
Perlinella ephyre	1	-99		
TRICHOPTERA				
Cheumatopsyche	126			1
Chimarra	2			
Helicopsyche	2			
Hydroptila	6			
Nectopsyche		2		3
Oecetis		1		3
Polycentropodidae				1
Triaenodes				4
TRICLADIDA				
Planariidae	8	8		2

ORDER: TAXA	CS	NF	SG	RM
TUBIFICIDA				
Branchiura sowerbyi		2		

Aquid Invertebrate Database Bench Sheet Report

Starks Ck [0218114], Station #1, Sample Date: 9/25/2002 1:15:00 PM

ORDER: TAXA	CS	NF	SG	RM
"HYDRACARINA"				
Acarina	6	1		1
AMPHIPODA				
Allocrangonyx		5		
Hyalella azteca				12
COLEOPTERA				
Berosus		1		
Dubiraphia		4		18
Helichus basalis	2			1
Helichus lithophilus	1			
Macronychus glabratus				10
Microcylloepus pusillus				5
Psephenus herricki	5	-99		
Scirtes				9
Stenelmis	4	8		
DECAPODA				
Orconectes luteus		1		
DIPTERA				
Ablabesmyia		8		2
Anopheles				2
Ceratopogoninae	1	3		
Chaoborus		1		
Chironomus	2	21		1
Cladotanytarsus	3	10		1
Corynoneura	4	4		15
Cricotopus/Orthocladus	4	1		12
Cryptochironomus		3		
Dicrotendipes		5		3
Diptera	1			
Dixella				7
Glyptotendipes	1			
Hemerodromia	1			
Hexatoma		-99		
Labrundinia		1		15
Microtendipes	4			
Myxosargus	1			
Nanocladius				1
Nilotanypus	2			3
Parachironomus				1
Paralauterborniella		1		
Parametriocnemus	3			
Paraphaenocladus				1
Paratanytarsus		6		17
Paratendipes	10	4		1
Phaenopsectra	1	7		
Polypedilum	2			
Polypedilum convictum grp	65			2
Polypedilum illinoense grp	7	1		15
Polypedilum scalaenum grp	2			
Procladius		3		

ORDER: TAXA	CS	NF	SG	RM
Pseudochironomus		2		
Rheocricotopus	3			
Rheotanytarsus	27	1		
Stempellinella	1	4		1
Stenochironomus				1
Tabanus	1			
Tanytarsus	20	28		15
Thienemanniella	4	2		2
Thienemannimyia grp.	27	1		9
Tipula	2			
undescribed Empididae	1	2		
EPHEMEROPTERA				
Acerpenna	13			2
Baetis	6			
Caenis anceps	32	100		3
Caenis latipennis	91	59		19
Choroterpes	8	3		
Heptageniidae	13	3		1
Hexagenia limbata		2		
Isonychia bicolor	68			1
Leptophlebiidae		9		3
Proclleon	1	6		
Stenonema femoratum	7	19		
Stenonema mediopunctatum	27			
Stenonema pulchellum	22			
Tricorythodes	7	1		2
HEMIPTERA				
Microvelia	1			
Rhagovelia	2			
ISOPODA				
Caecidotea (Blind & Unpigmented)		2		
LIMNOPHILA				
Ferrissia	2	13		4
Menetus		1		5
Physella	1			
LUMBRICINA				
Lumbricidae		1		
LUMBRICULIDA				
Lumbriculidae	2			
MEGALOPTERA				
Corydalus	3			
Sialis		-99		
MESOGASTROPODA				
Elimia		1		
Hydrobiidae	2			
ODONATA				
Argia	16	8		9
Boyeria				-99
Calopteryx				1
Didymops		-99		
Enallagma				16
Hagenius brevistylus	2	2		1

ORDER: TAXA	CS	NF	SG	RM
Stylogomphus albistylus	4	1		
PLECOPTERA				
Neoperla	1			
TRICHOPTERA				
Cheumatopsyche	9			
Chimarra	28			
Helicopsyche		1		
Nectopsyche				2
Oecetis	2			13
Triaenodes				27
TUBIFICIDA				
Branchiura sowerbyi		1		
Tubificidae		1		1

Aquid Invertebrate Database Bench Sheet Report

Barren Fk [0318682], Station #1, Sample Date: 3/26/2003 2:00:00 PM

ORDER: TAXA	CS	NF	SG	RM
"HYDRACARINA"				
Acarina	49	5		1
AMPHIPODA				
Allocrangonyx		1		
Hyalella azteca				39
Stygobromus	1	1		
COLEOPTERA				
Berosus	5	2		3
Dubiraphia		1		8
Ectopria nervosa	-99	2		1
Enochrus				2
Peltodytes		1		1
Psephenus herricki	7	2		2
Scirtes				1
Stenelmis	1	20		
DECAPODA				
Orconectes luteus				-99
Orconectes virilis				-99
DIPTERA				
Ablabesmyia		12		1
Ceratopogoninae	4	4		
Chaetocladius		1		
Cladotanytarsus	1	6		
Clinocera	1			
Corynoneura	12	8		20
Cricotopus bicinctus	5			11
Cricotopus/Orthocladius	53	2		34
Cryptochironomus		4		
Dicrotendipes	1	6		5
Dolichopodidae	1			
Eukiefferiella	11	1		2
Forcipomyiinae	1	1		
Hydrobaenus		2		
Labrundinia				11
Larsia				1
Micropsectra	1			
Myxosargus				1
Orthocladius (Euorthocladius)	1			
Parametriocnemus	12	3		
Paratanytarsus				8
Paratendipes	1	1		
Polypedilum convictum grp	15			
Procladius		1		
Prosimulium	5			
Pseudochironomus		2		2
Rheocricotopus	5			
Rheotanytarsus		1		
Stempellinella	2	12		
Stictochironomus		3		
Sympotthastia	26	3		5

ORDER: TAXA	CS	NF	SG	RM
Synorthocladius				1
Tabanus	1	1		
Tanytarsus	29	17		8
Thienemanniella				1
Thienemannimyia grp.	5	15		8
Tipula	-99			-99
Zavrelimyia				1
EPHEMEROPTERA				
Acentrella	4			
Acerpenna	3			
Caenis latipennis	57	72		70
Eurylophella				1
Heptageniidae	15			
Isonychia bicolor	5			
Leptophlebia	2	2		6
Leptophlebiidae	1			2
Siphonurus				2
Stenonema femoratum	22	41		16
Stenonema mediopunctatum	-99			
Stenonema pulchellum	11			1
Tricorythodes	6	2		
HEMIPTERA				
Microvelia				1
ISOPODA				
Caecidotea (Blind & Unpigmented)		1		
Lirceus				2
LEPIDOPTERA				
Petrophila		1		
LIMNOPHILA				
Ancylidae	2			4
Fossaria	1			
Menetus		3		1
Physella		4		1
LUMBRICULIDA				
Lumbriculidae		3		
MEGALOPTERA				
Nigronia serricornis	-99			
MESOGASTROPODA				
Elimia	4	4		27
ODONATA				
Argia	2			1
Basiaeschna janata				-99
Boyeria				-99
Calopteryx				-99
Enallagma				7
Epitheca (Epicordulia)				-99
Erythemis				-99
Libellula				-99
Stylogomphus albistylus	4	1		1
PLECOPTERA				
Acroneuria	-99			
Amphinemura	46	1		

ORDER: TAXA	CS	NF	SG	RM
Chloroperlidae	7	5		
Clioperla clio				-99
Isoperla	56	2		
Neoperla	1			
Perlesta		1		3
Perlinella drymo				-99
Perlodidae	13			
Zealeuctra	1	2		
TRICHOPTERA				
Agapetus	1			
Cheumatopsyche	13			
Chimarra	2	1		
Helicopsyche	1			2
Hydroptila	17	4		10
Oecetis	1			1
Oxyethira				1
Polycentropus	1	1		1
Pycnopsyche				-99
Triaenodes	1			4
TRICLADIDA				
Planariidae	1	1		2
TUBIFICIDA				
Enchytraeidae		1		
Tubificidae		18		

Aquid Invertebrate Database Bench Sheet Report

Deer Ck [0318684], Station #1, Sample Date: 3/31/2003 11:00:00 AM

ORDER: TAXA	CS	NF	SG	RM
N/A				
Gordiidae	1			
"HYDRACARINA"				
Acarina	32	5		2
AMPHIPODA				
Allocrangonyx	1	2		
Crangonyx	1	4		
Hyalella azteca		2		50
COLEOPTERA				
Dubiraphia		15		4
Ectopria nervosa				1
Hydroporus		6		1
Lutrochus	1			
Microcylloepus pusillus				2
Psephenus herricki	7			
Stenelmis	6	15		
DIPTERA				
Ablabesmyia		39		4
Atherix	1	1		
Ceratopogoninae	2	1		
Cladotanytarsus		3		
Clinocera	1			
Clinotanytus		2		
Corynoneura				1
Cricotopus bicinctus	1	1		1
Cricotopus/Orthocladus	33	10		64
Cryptochironomus		2		
Cryptotendipes		2		
Demicryptochironomus		1		
Dicrotendipes		7		3
Dixella				1
Einfeldia		1		
Eukiefferiella	40			4
Gonomyia	1			
Hemerodromia	1			
Hexatoma	7	2		
Hydrobaenus		4		
Labrundinia				11
Micropsectra				3
Parakiefferiella		1		
Paralauterborniella		2		
Parametriocnemus	66	2		
Paraphaenocladus				2
Paratanytarsus		6		27
Paratendipes		11		1
Phaenopsectra		3		2
Polypedilum convictum grp	18			1
Polypedilum halterale grp		1		
Polypedilum illinoense grp	1	1		3
Polypedilum scalaenum grp		2		

ORDER: TAXA	CS	NF	SG	RM
Procladius		28		
Prosimulium	4			
Pseudochironomus	1	4		1
Rheocricotopus	16			1
Rheotanytarsus	6			1
Robackia	2			
Stempellinella		4		
Stictochironomus		4		
Sympotthastia	2	3		2
Tabanus	5			
Tanytarsus	3	19		8
Thienemanniella	1			
Thienemannimyia grp.	10	12		5
Tipula	1	-99		
undescribed Empididae		1		
EPHEMEROPTERA				
Acentrella	10			
Acerpenna	2			
Caenis anceps		12		1
Caenis latipennis	19	21		12
Centroptilum				1
Heptageniidae	22	3		
Hexagenia		2		
Isonychia bicolor	19			
Leptophlebia				1
Paraleptophlebia	1			1
Siphonurus		1		15
Stenacron		1		
Stenonema femoratum	5	7		
Stenonema mediopunctatum	3			
Stenonema pulchellum	66			
Tricorythodes	85			
LEPIDOPTERA				
Petrophila	1			
LIMNOPHILA				
Ferrissia	3	3		1
Fossaria		1		
Helisoma				-99
Menetus	2			
Physella				1
LUMBRICULIDA				
Lumbriculidae	4			
MEGALOPTERA				
Corydalus	2			
MESOGASTROPODA				
Elimia	37	-99		4
Hydrobiidae	1	1		1
ODONATA				
Argia	1	2		2
Boyeria				1
Calopteryx				1
Enallagma		2		9

ORDER: TAXA	CS	NF	SG	RM
Hagenius brevistylus		1		
Macromia		1		
Stylogomphus albistylus	2	3		
PLECOPTERA				
Amphinemura	8			
Haploperla	3			
Isoperla	3			
Leuctridae	1	1		
TRICHOPTERA				
Agapetus	5			
Cheumatopsyche	11	1		
Chimarra	12			
Helicopsyche	20			
Hydroptila	9	2		15
Mystacides		4		
Neophylax	2			
Oecetis		1		3
Polycentropus	1	1		
Pycnopsyche				1
Triaenodes				2
TRICLADIDA				
Planariidae	8			
TUBIFICIDA				
Enchytraeidae		4		
Limnodrilus hoffmeisteri		3		
Tubificidae		3		
VENEROIDEA				
Sphaeriidae		2		

Aquid Invertebrate Database Bench Sheet Report

Macks Ck [0318683], Station #1, Sample Date: 3/26/2003 11:00:00 AM

ORDER: TAXA	CS	NF	SG	RM
"HYDRACARINA"				
Acarina	81	44		
AMPHIPODA				
Allocrangonyx		1		
Hyalella azteca				12
COLEOPTERA				
Berosus		1		
Dubiraphia	1	6		2
Psephenus herricki	9	2		
Stenelmis	9	31		1
DIPTERA				
Ablabesmyia		5		1
Ceratopogoninae	6	16		-99
Cladotanytarsus	2	18		
Clinocera	1	1		
Corynoneura	1	7		7
Cricotopus bicinctus	1			3
Cricotopus/Orthocladius	54	16		111
Cryptochironomus	1	1		
Dicrotendipes	1	3		7
Eukiefferiella	5	1		
Forcipomyiinae	1			
Hemerodromia	3			1
Hexatoma	1	1		
Hydrobaenus	1	2		
Labrundinia		7		46
Microtendipes	8	5		
Natarsia		1		
Orthocladius (Euorthocladius)	1			
Paracladopelma		1		
Paratanytarsus		2		15
Paratendipes		3		
Phaenopsectra		9		
Polypedilum convictum grp	8			
Polypedilum illinoense grp		1		11
Polypedilum scalaenum grp	1			
Potthastia	2			3
Procladius		1		
Prosimulium	5			
Pseudochironomus	7			
Rheocricotopus	24			
Rheotanytarsus	1			4
Stempellinella	1	6		1
Stenochironomus		1		
Stictochironomus		1		
Sympotthastia	37	1		6
Tabanus	1			
Tanytarsus	9	12		
Thienemanniella	2	7		2
Thienemannimyia grp.	13	5		7

ORDER: TAXA	CS	NF	SG	RM
Tipula	1			
undescribed Empididae		1		
Zavrelimyia				1
EPHEMEROPTERA				
Acentrella	3			
Acerpenna	3			
Anthopotamus		-99		
Baetisca lacustris		1		
Caenis latipennis	51	58		26
Centropilum				1
Ephemerellidae	1			
Eurylophella bicolor	3	4		2
Heptageniidae	3			
Isonychia bicolor	11			
Paraleptophlebia	2			3
Siphonurus		2		34
Stenonema femoratum	10	6		
Stenonema mediopunctatum	1	1		1
Stenonema pulchellum	5			
Tricorythodes	12	1		1
ISOPODA				
Caecidotea		3		
LIMNOPHILA				
Ancylidae		1		
Fossaria	2			
Menetus	2			
Physella		1		
LUMBRICINA				
Lumbricidae		-99		
MEGALOPTERA				
Corydalus	-99			
MESOGASTROPODA				
Elimia	7	2		13
Pleurocera	1			
ODONATA				
Argia	6	3		
Basiaeschna janata				1
Enallagma				5
Hagenius brevistylus		1		
Stylogomphus albistylus	2	-99		
PLECOPTERA				
Amphinemura	31			
Chloroperlidae	1			
Isoperla	13			
Neoperla	2			
Perlesta				3
Perlinella drymo		-99		
Perlinella ephyre	5	4		
TRICHOPTERA				
Cheumatopsyche	31	-99		1
Chimarra	2			
Helicopsyche	4	1		

ORDER: TAXA	CS	NF	SG	RM
Hydroptila	5			3
Oecetis		1		
Polycentropus		-99		1
Pycnopsyche				-99
TRICLADIDA				
Planariidae	6	2		
TUBIFICIDA				
Branchiura sowerbyi		1		
Tubificidae		3		

Aquid Invertebrate Database Bench Sheet Report

Starks Ck [0318685], Station #1, Sample Date: 3/31/2003 1:30:00 PM

ORDER: TAXA	CS	NF	SG	RM
"HYDRACARINA"				
Acarina	7			
AMPHIPODA				
Crangonyx	1	2		9
Hyaella azteca				8
ARHYNCHOBDELLIDA				
Erpobdellidae		-99		
COLEOPTERA				
Chaetarthria				1
Dubiraphia	1	1		2
Helichus basalis	2			
Hydroporus		1		1
Macronychus glabratus				1
Microcylloepus pusillus	1			1
Psephenus herricki	6			
Scirtes				7
Sperchopsis		1		
Stenelmis	2			8
DECAPODA				
Orconectes luteus		-99		
Orconectes virilis				-99
DIPTERA				
Ablabesmyia		4		3
Ceratopogoninae	1	2		
Cladotanytarsus		11		
Clinocera	2	1		
Corynoneura		1		2
Cricotopus bicinctus	1			6
Cricotopus/Orthocladius	26	4		15
Cryptochironomus		1		
Dicranota	2			
Dicrotendipes		3		2
Dixella				16
Ephydridae		1		
Eukiefferiella	17	1		2
Hemerodromia	1			
Hexatoma	2	2		
Hydrobaenus	1	9		
Labrundinia				4
Microtendipes	2			
Myxosargus				1
Nemotelus	1	1		
Orthocladius (Euorthocladius)	6			2
Paralauterborniella		1		
Parametriocnemus	29			2
Paratanytarsus	1			34
Paratendipes		41		
Phaenopsectra		7		5
Polypedilum convictum grp	13			
Polypedilum fallax grp	1			

ORDER: TAXA	CS	NF	SG	RM
Polypedilum illinoense grp	1	2		17
Polypedilum scalaenum grp	1	3		
Procladius		12		
Prosimulium	1			
Pseudochironomus	1	4		
Rheotanytarsus	1			2
Robackia	1			
Stempellinella	3	4		
Stictochironomus	1	6		
Sympotthastia	19	2		10
Tabanus	1	1		
Tanytarsus	19	73		26
Thienemannimyia grp.	8	1		2
Tipula	-99			
EPHEMEROPTERA				
Acentrella	10			
Caenis anceps	6			
Caenis latipennis	231	92		38
Ephemerella needhami	3			
Eurylophella bicolor				1
Heptageniidae	16			
Hexagenia limbata		2		
Isonychia bicolor	12			
Leptophlebia		1		3
Leptophlebiidae				1
Siphonurus		1		8
Stenonema femoratum	32	2		1
Stenonema mediopunctatum	8			
Stenonema pulchellum	1			
Tricorythodes	4			
HEMIPTERA				
Microvelia				1
LIMNOPHILA				
Ancyliidae	4	5		
LUMBRICINA				
Lumbricidae	2	-99		1
LUMBRICULIDA				
Lumbriculidae	1			
MEGALOPTERA				
Corydalus	-99			
MESOGASTROPODA				
Elimia	3			
ODONATA				
Argia	2	1		3
Basiaeschna janata				1
Calopteryx				2
Enallagma				4
Stylogomphus albistylus	4	1		
PLECOPTERA				
Acroneuria	1			
Amphinemura	35			1
Chloroperlidae	8			

ORDER: TAXA	CS	NF	SG	RM
Clioperla clio	-99			1
Isoperla	31	1		1
Perlesta	28	2		47
TRICHOPTERA				
Cheumatopsyche	1			
Chimarra	6			
Helicopsyche				1
Hydroptila	4	1		2
Oecetis				1
Polycentropus	1			
Pycnopsyche				2
Triaenodes				7
TRICLADIDA				
Planariidae	1			
TUBIFICIDA				
Branchiura sowerbyi	1	1		
Enchytraeidae				2
Limnodrilus hoffmeisteri	1			
Tubificidae	2	2		
VENEROIDEA				
Corbicula		28		

